THE AEROPLANE and ASTRONAUTICS

APRIL 6, 1961

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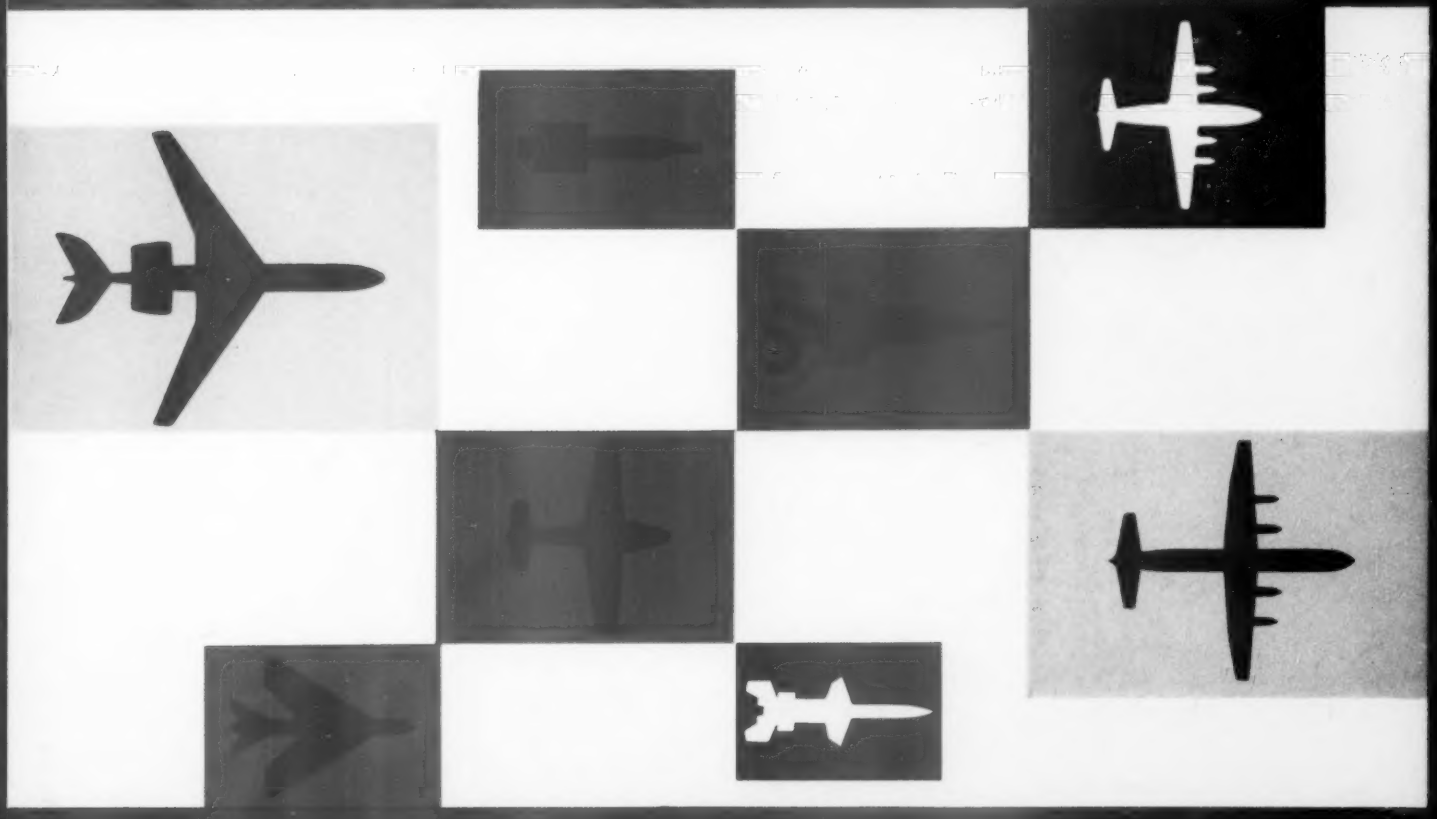

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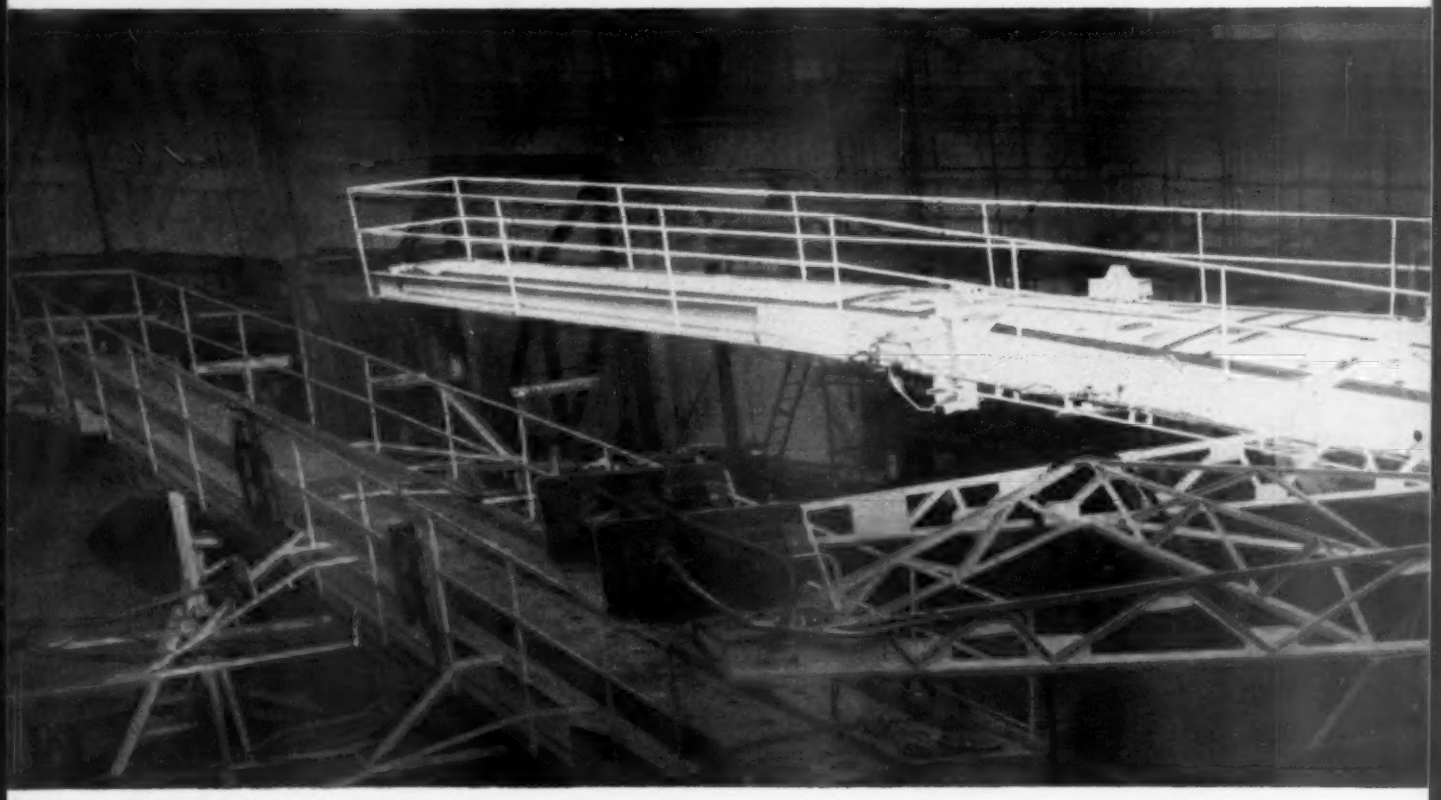

*This is one of seven indicators in the VC.10 fuel load control panel which enable any desired weight of fuel to be selected for the tank concerned. These gauges automatically control fuel load in their respective tanks to pre-set quantities.*

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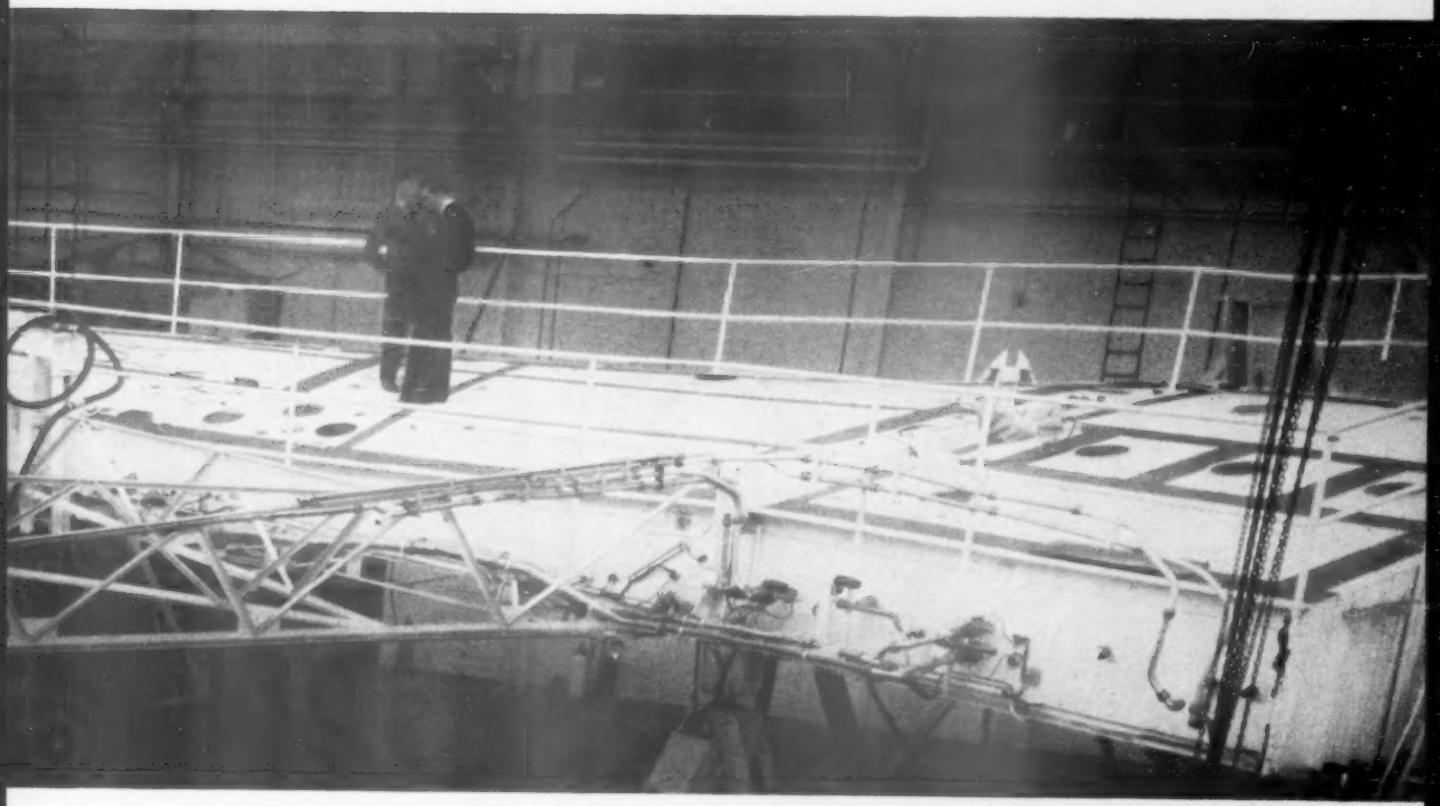

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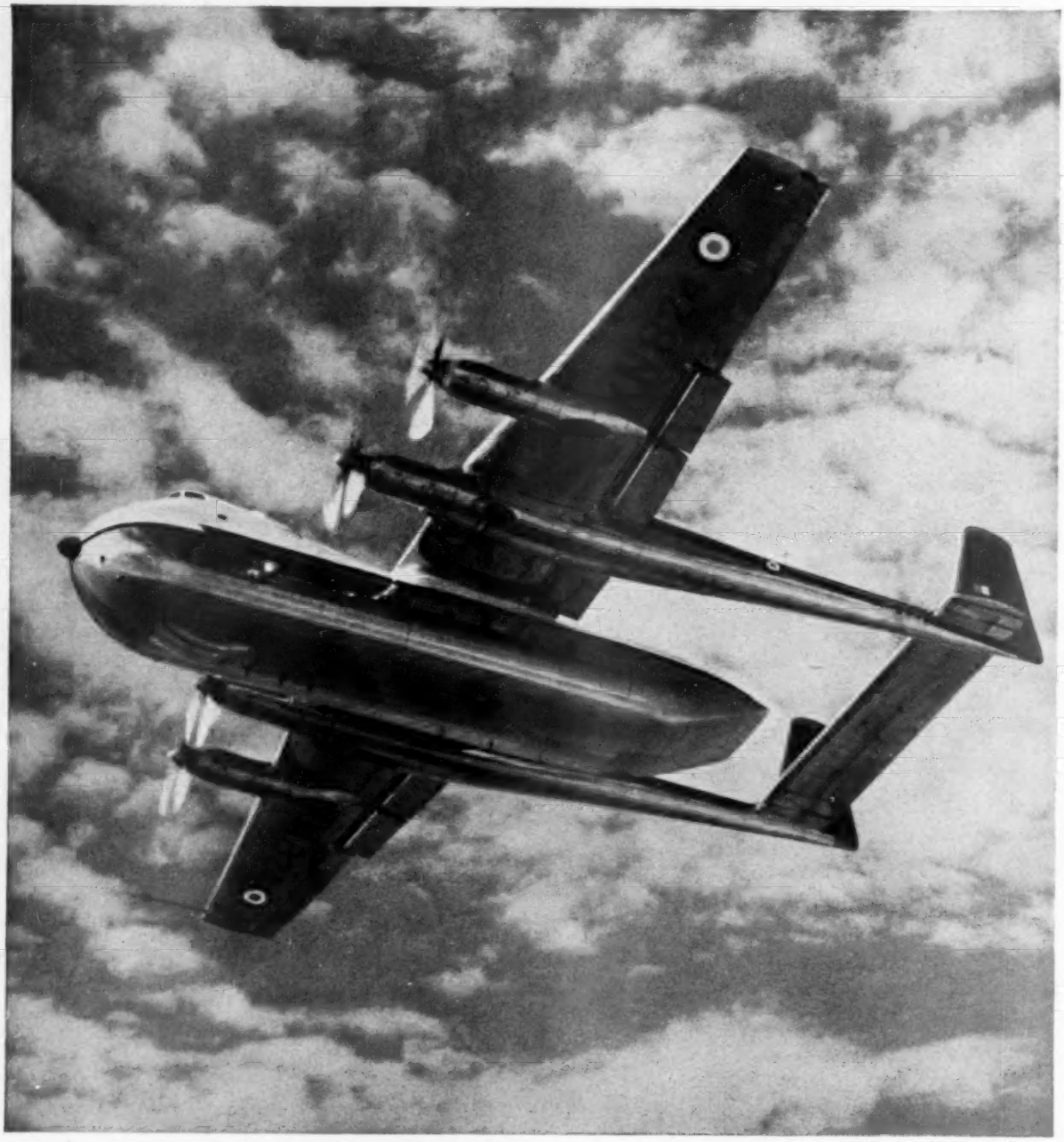

# ARGOSY C. Mk.1

Choice of Transport Command

**HAWKER SIDDELEY AVIATION**

32 Duke Street, St. James's, London, S.W.1

THE AEROPLANE and ASTRONAUTICS

VOLUME 100 NUMBER 2581 APRIL 6, 1961

# Explosion Point

Signs and portents are not lacking that the pot of trouble at L.A.P. as it is familiarly called, or to give the airport its full bureaucratic title, London (Heathrow), is about to boil over. Incidentally, what a wealth of implication is in the nice distinction London (Heathrow) and London (Gatwick). According to the guide-book Gatwick is a well-known racecourse on the outskirts of Horley, an attractive residential town south of Redhill, 26 miles from London. Heathrow is 17 miles to the west. With such distances involved, surface transport is obviously a matter of the first importance. Until the British Transport Commission provides railway services, buses or cars will have to be used.

It is true that at last the first necessary step, so long a time advocated in these columns, is now being discussed by the Government, namely the setting up of an independent authority to run both L.A.P. and presumably Gatwick. But the doing of this has been put off for so long that, before it can be done, there is likely to be an explosion over the lack of space for parking cars.

Everywhere that one goes the inadequacies of L.A.P. are aired. The travelling public naturally are not particularly worried by the ultra-high landing fees about to be charged the airlines, though they naturally take a poor view of the wartime hutments that form the North side arrival and departure point. What the public is getting increasingly fed up with are the muddle and confusion over the parking of cars. Their tempers will not be mollified by the imposition of swingeing parking fees.

It seems almost incredible that an airport could be laid out 17 miles from its metropolis and yet not be provided with adequate car space to allow the setting down and picking up of passengers. It certainly makes a nonsense of Government planning.

# Back to the Pilot

The shattering impact of political decisions on technical development and aeronautical progress has been frequently experienced in this country. Increasingly, as the countries of the World integrate themselves more closely with defence pacts and regional groupings, we in aviation must expect to experience the impact of political decisions made by other Governments.

Last week President Kennedy in a special message to the U.S. Congress suggested substantial increases in the defence budget. This country is immediately affected by the changes in the U.S. plans for Skybolt, the air-launched ballistic missile for the U.S.A.F. which is also to be supplied for bombers of the R.A.F.

This aspect and others are discussed on p. 358. An incidental point will be the impact of the decision to slow down on the B.70 M=3 bomber. This must hearten the supporters in this country of the M=2.2 civil transport. Among them is Dr. Russell, whose latest views are dealt with at some length on p. 359 and p. 370.

Another important outcome of the changed outlook in U.S. defence planning, as indicated by the President's message, is the renewed emphasis on armament for conventional warfare. This must mean in turn a further retreat from the full reliance in this country on the deterrent weapon. Not only will the R.A.F. want its troop-carrying aircraft but it will need tactical aircraft. The day of the pilot is not done yet!

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# Matters of Moment

## Air University at Cranwell

IT has been decided to move the R.A.F. Technical College from Henlow and merge it with the R.A.F. College at Cranwell. Announcing this during his visit to Cranwell last week, Mr. Julian Amery, Secretary of State for Air, said that the proposed merger would take place in about three years' time when additional equipment and buildings are ready.

This integration of the two cadet colleges is intended to provide the Service with a complete "university of the air." At the present time the R.A.F. College, Cranwell, comes under the administrative control of Flying Training Command, and the R.A.F. Technical College, Henlow, is controlled by Technical Training Command.

## More U.S. Missiles, Fewer Aircraft

MANY of the defence decisions announced last week by President Kennedy of the U.S. have important implications for Britain. In a special message to Congress he suggested a wide range of defence changes. He asked for additional appropriations of $1,954 million, of which $650 million would be spent in the 1962 fiscal year. This would bring the total U.S. defence budget to $43,800 million.

Programmes to benefit include Polaris submarines and missiles, which are to be greatly accelerated; the Minuteman ICBM, for which productive capacity is to be doubled, and the number of fixed-base squadrons is to be increased by 66% at the temporary expense of the mobile squadrons; the Skybolt ALBM, which is to receive an extra $50 million; the heavy bomber force—provision is to be made for one-eighth of the force to go on to continual airborne alert, with authority for the cost of a full alert if necessary; the Dyna-Soar, Midas, Advent, Defender and Discoverer space programmes; and military airlift.

Money is to be saved on the Titan ICBM, the last two squadrons of which are to be cancelled; the B-47 bomber, which is to be phased out faster than originally planned; the Snark missile, which is to be cancelled; the Mach-3 B-70 bomber, of which only four prototypes are now to be built; the nuclear-powered aircraft, which is to be handed over to the Atomic Energy Commission as a "non-defence research item," the Eagle AAM, which is to be cancelled; 73 U.S. and overseas military installations which are to be closed.

From the British viewpoint, the Skybolt and B-70 decisions are particularly significant. The Eisenhower cuts in Skybolt development have been restored and it now seems possible that this missile will become available for R.A.F. Vulcans as originally planned.

The B-70 has had a chequered career and will no longer be developed as a bomber. Its advantages as a second-strike system are not considered so much better than those of a cheaper missile or a B-52 with Skybolts as to justify expenditure of $358 million in the next fiscal year. The aircraft with its bombing and navigation systems will be developed on a limited scale ($1,300 million) to gain Mach-3 flight experience.

The cut-back may well affect the U.S. attitude to the production of a Mach-3 airliner. Obviously the B-70 is to be developed at a relatively low priority and only limited flight experience will become available with the prototypes built. It would have been much easier to sell Mach-3 airliners to operators if these could have been backed by extensive Mach-3 flight experience with military B-70s.

## Anglo-French Co-operation

A GREAT deal has been said in recent months on the desirability of closer liaison between the British and French aircraft industries. Co-operation is already firmly established; one of the most successful of current civil projects, the Sud Caravelle, was designed around the Rolls-Royce Avon and the nose of the Comet. British powerplants and accessories are installed in a number of French aircraft designs.

Both airframes and engines of British origin have been built under licence in France in recent years, but hitherto, the return traffic of French aeronautical imports has been negligible. A few light gas-turbine powerplants have been procured, mainly for ground-starting units, and the only complete aircraft obtained from France have been a few Alouette helicopters for the British Army. There is of course the Turbomeca licence held by the Blackburn company.

Co-operation is necessarily a two-sided process, and the absence of British orders for French equipment has been not through default in bilateral bargaining so much as failure to find specific products not already covered by existing designs in the U.K. With the sustained vigour of the French industry, however, this situation is changing. Whereas Britain is maintaining its unrivalled position as a supplier of large powerplants *par excellence* the French have some extremely attractive airframes to their credit.

Of these, there is one which seems to be of interest to the Royal Air Force, whose versatile Canberras, except for the newer P.R. versions, are finally moving towards a well-deserved retirement. In due time, it has been officially stated, they are to be replaced by the BAC TSR-2 which, having yet to fly, is undoubtedly some considerable way from entering service. In the meantime, a replacement with M=2 capability is available in France and, as our report on page 367 indicates, the Dassault Mirage IV is now undergoing operational trials.

As the spearhead of the French deterrent, the twin-jet Mirage IV is primarily intended for the strategic strike rôle, using flight refuelling to obtain an operating range of about 2,500 miles. It has already proved capable of a sustained supersonic "dash" at more than M=2 for over 30 minutes at a time, and is undoubtedly the most advanced design in its class now flying. It is to be in service with the French Air Force before 1964.

In such circumstances it is understandable that our friends in France feel that the existence of the Mirage IV offers an opportunity to make the co-operation between our two countries two-way. The fact that the installation of Rolls-Royce turbojets would increase its striking radius only strengthens this French belief.

NEW AT DORVAL.—This large $30 million air terminal building has been in use at Dorval Airport, Montreal, since the beginning of the year. Montreal is to be the venue later this month of IATA's first technical conference on supersonic aircraft.

EASTERN TERMINAL.—Opening this month is the modern terminal building at Paya Lebar Airport, Singapore. The first international air show at Singapore is to be held from Apr. 8 to 16.

## Joining the Hawker Siddeley Board

MR. G. C. I. GARDINER, C.B.E., M.I.Mech.E., F.R.Ae.S., has been appointed to the Board of Hawker Siddeley Aviation, Ltd., as technical director (guided weapons). In this capacity he will be responsible for the co-ordination of all the company's activities in the guided weapon and space fields.

Born in 1916, Mr. Gardiner was educated at Westminster School and the de Havilland Aeronautical Technical School. After finishing his course in 1938, he became a member of the design office of the de Havilland Aircraft Co., Ltd. In 1943 he transferred to the company's Propeller Division as a designer and in 1945—by which time it had become de Havilland Propellers, Ltd.—he became its chief designer. In 1947 he was appointed engineering manager and the following year became chief engineer. He was appointed to the Board of de Havilland Propellers in 1952 and in 1959 became technical director and chief executive of the Ballistic Missiles section.

Having been responsible for the development of Blue Streak both as a military weapon and as a potential boost unit for space research statellites, Mr. Gardiner takes to his new responsibilities a wide knowledge and understanding of the problems involved in guided weapons and astronautics.

## Supersonic Airliner Features

NO official details have yet been given of the supersonic airliner for which the British Aircraft Corporation holds an M.o.A. design study contract. But a great deal of information can be deduced from the text of Dr. A. E. Russell's lecture before the Guild of Air Pilots and Air Navigators (reported on p. 372) and his answers to the discussion afterwards.

Believed to be designated the Bristol 198, this aircraft is designed for non-stop transatlantic operation cruising at Mach 2.2 and carrying 120 passengers. It will be of narrow delta configuration with six engines, probably turbofans, having reheat which will be used only for transonic acceleration. The airframe will be of comparatively conventional aluminium-alloy construction, but the sharp wing-leading-edges, air-intake lips and other parts subject to extreme heating will be of steel.

For transatlantic operation its all-up weight is likely to be about 337,000 lb. Empty weight will be 152,000 lb.; payload and crew, 33,700 lb. and fuel load 151,000 lb. During the crossing 124,000 lb. of fuel will be used and the reserves of 27,000 lb. make up 8.1% of the all-up weight, compared with 10% for payload plus crew.

All fuel will be carried in the wing and a simple baffle system will prevent excessive conduction of heat to it from the skin; complete insulation of tanks will not be necessary. Fuel will be used as a heat sink for cooling cabin air. The cabin differential pressure will be 11 p.s.i., equivalent to a cabin altitude of 5,000 ft. when cruising at 60,000 ft. Air for the cabin will initially be cooled by the engine boundary-layer bleed air, followed by a fuel-cooled heat-exchanger and then by a three-stage freon system.

Because of the high angle of incidence during take-off and landing, the nose will pivot to give a better view for the pilots. During cruising flight they will have no forward vision because the front windscreen panels will be covered by a visor to reduce drag and protect the panels from excessive heating.

There will be automatic flight systems to cover all phases of the flight including take-off, climb, cruise, descent and landing, according to Dr. Russell. These features will be incorporated mainly to allow savings in fuel reserves. But without automatics the aircraft will handle well, the main difference between it and conventional types being its roll-yaw coupling characteristics.

Because of the high thrust/weight ratio, the aircraft will have a relatively short take-off run. Its landing run will be longer, but it will operate comfortably from a 10,000 ft. runway. Its take-off speed will be 185-190 kt. and its approach speed 140 kt. Auto-throttle will be used to aid piloting during the approach.

To reduce noise after take-off the aircraft will accelerate rapidly to its minimum drag speed of 280 kt. and then reduce power and climb initially on just under a 5% gradient at 1,500 ft./min. The climb will be continued at about 400 kts. E.A.S. to 25,000 ft., at a rate of 10,000 ft./min. Beyond this, speed will be held to Mach 0.95 until 40,000 ft. when transonic acceleration will be made. Cruise speed will be reached just under 60,000 ft. after covering over 500 miles in about 30 minutes.

On a 3,000 n.m. stage, the aircraft will cruise at Mach 2.2 for the next 2,000 n.m. climbing 6,000 ft. during this time. During this stage the aircraft could, in emergency, decelerate to Mach 1 in 50 miles. At the end of the cruise the transonic deceleration will be made just below 50,000 ft. The complete journey, allowing for taxi-ing time, will be about 185 minutes.

For the same direct operating costs as a subsonic type (apparently the Boeing 707), Dr. Russell estimated that this supersonic aircraft should have a first cost only about 17% greater. In this case it can be calculated that each aircraft should cost under £2¼ million. If operating costs can be 15% greater, the first cost could go up to just over £3 million.

## Hawker Siddeley Retirement

FROM the Hawker Siddeley Group comes news that Sir William Farren, C.B., M.B.E., M.A., D.Sc., F.R.S., M.I.Mech.E., Hon. F.R.Ae.S., Hon. F.I.A.S., technical director of A. V. Roe and Co., Ltd., and a director of Hawker Siddeley Aviation is to retire. According to the official announcement "having reached an age at which he finds the executive responsibilities of his position in the Hawker Siddeley Aviation companies an increasing burden [he] will shortly retire from active duties on the Board of Hawker Siddeley Aviation, Ltd., and A. V. Roe and Co., Ltd. He has, however, accepted an invitation to continue his association with Hawker Siddeley Aviation, Ltd., as a consultant."

Born in 1892 and educated at Perse School and Trinity College, Cambridge, Sir William started his aeronautical career in 1915 when he went to the Royal Aircraft Factory at Farnborough in charge of aerodynamic experiment and design. In 1918 he joined the technical staff of Armstrong Whitworth Aircraft and in 1920 became lecturer on engineering and aeronautics at Cambridge—which post he held until 1937.

In 1937 he was appointed deputy director of scientific research at the Air Ministry and two years later became deputy director of research and development (aircraft). In 1940 he became director of technical development at the Ministry of Aircraft Production. From 1941-1946 he was director of the Royal Aircraft Establishment at Farnborough, after which he joined Blackburn Aircraft, Ltd., as technical director. He joined the Avro team in 1947 and was appointed to the Board of Hawker Siddeley Aviation in 1959.

## Excellent Export Figures

IN the first two months of this year aircraft-industry exports were worth £25.3 million, nearly £2 million more than for the same months of 1960 and only £280,000 less than the record 1959 January/February total. The aero-engine exports of £14.3 million were about £4 million above the previous record for the first two months of any year, which was achieved in 1960.

Dollar sales accounted for more than £11 million of the total, the value of aero-engines and Vanguard airliners delivered to Canada amounting to about £5½ million. Exports to the United States, mainly of aero-engines, accounted for the remaining £5½ million.

## Above 32 Miles

A RECORD height of 169,600 ft. was reached by an X-15 research aircraft on Mar. 30. This was 33,100 ft. higher than an X-15 had flown before. Joseph Walker, chief engineering test pilot of NASA, flew the aircraft and experienced two minutes of weightlessness at the top of the climb.

Two difficulties were experienced. The XLR-99 rocket motor cut out momentarily just after the X-15 was dropped, and the aircraft experienced very severe buffeting when it was decelerating.

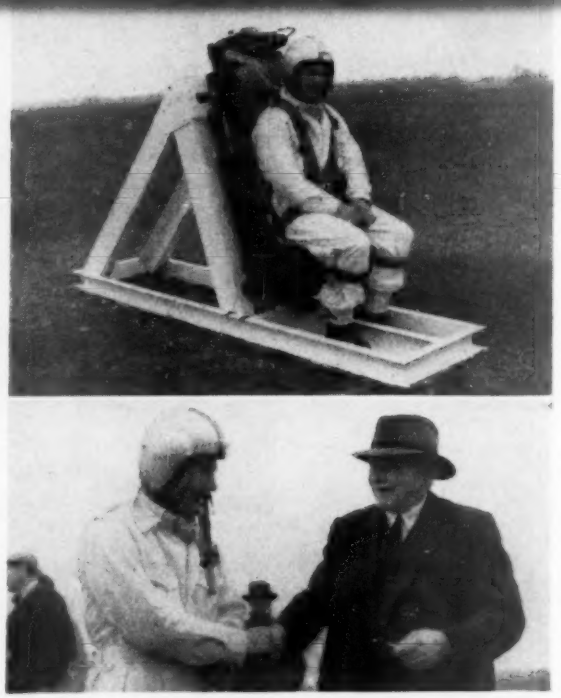
Walker is reported as saying "I have never experienced anything like it. I and the airplane window were going in opposite directions." A rapid inspection of the aircraft revealed no structural damage.

## From VC11 to BAC-111

RECENT discussions between the British Aircraft Corporation and airline representatives have led to development of a new short-haul jet transport project known as the BAC-111 (the "One-Eleven"). This project supplements, rather than replaces, the BAC-107 from which it is derived. The 107 was originally designed by Hunting Aircraft some four years ago as one of the first really short-haul jet projects; it was then based on two Bristol Orpheus engines and accommodated about 50 passengers. Subsequently, after Hunting joined the British Aircraft Corporation, the design was developed, in collaboration with the Vickers project and sales teams, to have Bristol Siddeley BS75 turbofans, a rather larger fuselage and other features already adopted by Vickers on the VC10 family.

Although the BAC-107 has been favourably received by many airlines, the views of a substantial number have now led to development of the BAC-111. A little larger—for ranges of 1,500 miles rather than 1,000-miles—the BAC-111 could also be available earlier by using Rolls-Royce Spey (RB 163) engines.

One consequence of the B.A.C. decision to go ahead with the BAC-111/BAC-107 projects—probably as a joint private/Government venture—is likely to be that the VC11 medium-haul member of the VC10 family will not now be built. At least one airline had taken firm options on the VC11, but BAC needed a substantial number of orders before committing this type to production.



ZERO-ZERO.—The first live ejection in history at zero height and zero speed was made by Mr. W. T. H. Hay at Chalgrove on Apr. 1 with a rocket-assisted Martin-Baker seat (top). With the initial impetus of the ejection gun, the rockets gave a peak altitude of more than 300. ft. to Mr. Hay, who is seen (above) being congratulated by Mr. James Martin, after his vertical take-off.

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***Air Matters in Parliament***

## L.A.P.—Time for Independence

IN the House of Commons in the small hours of Mar. 24 (at 2.35 a.m. in fact) SIR A. V. HARVEY (Cons, Macclesfield) again raised the thorny issue of charges and facilities at London Airport, in view of the Minister of Aviation's declared intention to raise landing fees by 33⅓% in April. Charges generally were raised by 50% in 1957 and by a further 28% a year ago, and the new increase will result in a fee of £243 for landing a Boeing or Douglas jet airliner. This, he said, will compare with a fee of £138 in New York, £115 in Paris, £117 in Brussels, £102 in Rome, £74, £71, £58 and £50 in Copenhagen, Frankfurt, Zurich and Amsterdam respectively, and £139 in Hong-Kong. In the absence of evidence to the contrary, he believed London had the unenviable distinction of possessing the most expensive airport in the World, with the possible exception of Khartoum.

With our enormous scale of charges one might at least expect to see some first-rate amenities. But in point of fact London Airport facilities in general were deplorable—for instance, car parking was notoriously chaotic, and to reach cars awaiting them, incoming passengers had to carry their bags across railway sleepers, sometimes in the dark. The only remedy produced by the Ministry was to raise parking charges to an exorbitant level—which was no remedy at all. The truth was that London Airport was already out of date.

It was obvious that the costs of running our airports were considerably higher than those of other countries, and for this he blamed the present régime of Government management. An independent authority, he argued, would be comparatively free from Parliamentary pressures and better able to deal with labour problems. It would also be free from cumbersome Civil Service procedures.

The forthright denunciation drew from MR. GEOFFREY RIPPON, Parliamentary Secretary to the Ministry of Aviation, an admission that the operational basis of our internationally used airports is now under review and that the question has to be decided whether or not the time has come to hand over responsibility to some form of independent public authority, perhaps analogous to the Port of London Authority.

So far, so good. But Mr. Rippon went on to the matter of charges at London Airport, and here he was distinctly less happy. For some reason best known to itself, the Ministry of Aviation makes a coy dive for base every time airport charges are mentioned. Once again the House was treated to the evasive statement that it is impossible to produce comparative analytical figures for our own and foreign airports owing to arbitrary inclusion in the case of the latter of ancillary and extraneous services in landing and other charges—for example, the basis of compilation of charges at New York is, it is alleged, unknown—and that therefore the fees cited were meaningless in this context.

Now this strikes us as plain humbug. Either the charges at London Airport are justifiable or they are not. If they are not, then turn the place inside out, find the open plug-hole and stop it up. If they are, then produce some supporting evidence, and scotch the widely held impression to the contrary. We are not convinced that it would overtax the ingenuity, or break the health, of some properly qualified investigator, were such a one deputed, to produce comparative statistics.

As to transferring the conduct of London Airport, and perhaps Gatwick as well, to an independent public body, this is a step we have consistently advocated.

The running of a major international airport is a business in its own right and calls for specialist management in the highest degree. It is, or should be, essentially a small-profits-quick-returns concern, with an enormous turnover. As in all such undertakings, even venial acts of maladministration, if multiplied and persisted in, can effectively turn what should be a resounding profit into a devastating loss. To put it bluntly, we have a feeling that the problems involved have got beyond the capacity of the present administration—and that is intended to cast no slur upon those who are doing their best in difficult circumstances. And this may well be at the root of failure

to justify present fees—or so one may be pardoned for suspecting in view of official reticence.

As we see it, the way out is to set up an executive controlling body with autonomous authority within a mandated sphere of action. The long-term objective of the controlling body must be ultimately to make the airport self-supporting without recourse to subsidy, and all policy must be dictated with this end in view. Commercial accounting procedure must march *pari passu* with events, and not lag a year behind as seems an inevitable concomitant of nationalized industry; strictest economy is vital, but not to the point of impairing the value for money of the end-product; and planning must be informed, forward-thinking and exhaustive. The project will obviously require unfettered application by the best—and therefore the dearest—brains available. Paradoxically therefore, for a start, are the executive salaries at present paid at London Airport high enough to ensure the rigid overall economy of operation so direly needed?

London Airport is inescapably one of those prestige institutions on which we are judged overseas. On this score alone, it must be placed on a sound basis. And the time to set about the task is—NOW.—O.W.H.C.

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## Memorial at Pembroke

REPRESENTATIVE of all the Sunderlands which fought so worthily over so many seas, in the Korean war, as in the wars against Germany and Japan, a Sunderland Mk. V, ML 824 of the French Naval Air Service, flew into Pembroke Dock on Mar. 24. It had come, escorted by two Shackletons of Coastal Command, from Brest, the gift of the French Government as a result of the persistence of Mr. Peter Thomas, who launched his campaign to save a Sunderland last September.

The ceremonial handing over by Commander Paul Lutherean was watched by Mr. Oswald Short, the last survivor of the three Short Brothers whose pioneering efforts had provided, first Imperial Airways with the Empire Boat and then the R.A.F. with the class of flying-boat which did so much in the hands of Coastal Command to defeat the submarines. The ceremony was attended by the present A.O.C.-in-C. Coastal Command, Air Marshal Sir Edward Chilton, and also by several officers who flew in ML 824 during the War.

Originally flying with No. 201 Squadron from Pembroke Dock and Castle Archdale, Northern Ireland, the flying-boat was later taken over by No. 330 (Norwegian) Squadron and then by the French Navy.

The last operational flight by an R.A.F. flying-boat was made by a Sunderland of No. 205 Squadron on May 15, 1959.

ML 824 is to be preserved ashore at Pembroke Dock to serve as a memorial of the part played by the five marks of Sunderland in 21 years of continuous service. Sunderlands of Coastal and Middle East Commands were credited with 28 confirmed submarine "kills" and shared with Allied surface craft the responsibility for the destruction of seven others.

The men that they rescued from Crete and Greece are not likely to forget the part that Sunderlands played in saving life, either.

The R.A.F. flying-boat could fight for its own life too. On one occasion a Sunderland shot down three out of eight attacking Junkers Ju 88 fighters. Some Sunderlands had a specially devised installation of machine-guns in the leading edge of the wing which proved its worth in dealing with gun-crews on U-boats.

British-designed and built, having American engines, this Sunderland Mk. V, ML 824, is being flown by an aircrew of the French Naval Air Service to its last resting place at Pembroke Dock (above), to serve as a memorial. It saw operational service with the R.A.F. and Royal Norwegian Air Force as a Mk. III. Delivered to the French Navy in that form in 1951, it was modified to Mk. V standard in 1954.

*Photographs copyright "The Aeroplane and Astronautics"*

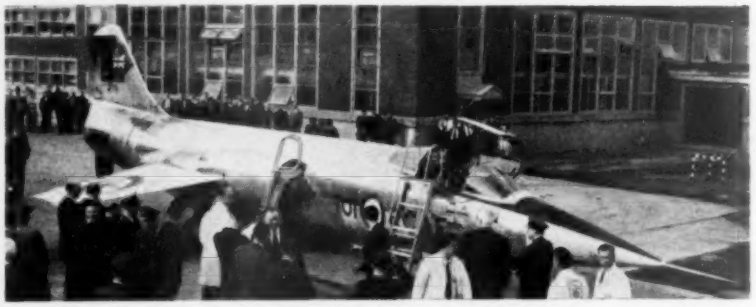
# *Aviation News in General*

**MORE CARIBOUS.**—The U.S. Army has ordered 10 more DHC-4 Caribous, and has now placed firm orders for 61 out of a total requirement said to be 300. With eight for the Ghanaian Air Force and five for the R.C.A.F., sales of this Canadian STOL transport to date total 74.

**AUSTRALIAN MIRAGE.**—According to Mr. McEwen, acting prime minister, the Australian Government aircraft factory at Melbourne will be given the main responsibility for manufacturing the Dassault Mirage fighter for the R.A.A.F. The Commonwealth Aircraft Corporation, also in Melbourne, has been invited to build the engine and about one-third of the airframe. Final assembly and flight-testing will be at the Government factory. Choice has yet to be finalized on the Atar or the Avon engine for the R.A.A.F. Mirages; trials with the Rolls-Royce unit are proceeding very satisfactorily in France.

**MEXICAN UTILITY.**—Maiden flight of the first Mexican-built LASA-60 was on Mar. 21 from the Lockheed-Azcarate airfield at San Luis Potosi. Designed and developed by the Georgia division of the Lockheed Aircraft Corpn. it was due to be produced by Macchi in Italy and Lockheed-Kaiser in Argentina. Power-plant is a 260-h.p. turbo-supercharged Continental engine.

**BREGUET AT LE BOURGET.**—A full-scale mock-up of the STOL Breguet 942 will be exhibited at the Paris Aero Show in Air-Inter colours. This version of the Breguet 94 family (see our previous issue) has a 45-seat interior with folding seats, and was developed jointly by Air-Inter and the French Railways (S.N.C.F.). Air-Inter is the French domestic operator, at present using aircraft on charter from Air France, U.A.T. and T.A.I.; its future requirements were recently stated to include two turboprop types, seating about 15 and 40 passengers respectively.



ROLL-OUT.—First of the 200 CF-104s for the Royal Canadian Air Force was rolled out at Canadair Ltd., Montreal, on Mar. 27. The Canadair CF-104 strike-reconnaissance aircraft will enter service with the R.C.A.F. No. 1 Air Division, which operates with NATO forces in Europe.

**H.S.-NORD VTOL.**—According to the vice-president of Nord-Aviation, the company has abandoned its own project for a NATO V/STOL tactical-support fighter and has associated itself with Hawker Siddeley in this venture.

**NEPTUNE REPLACEMENT.**—The first production Lockheed P3V-1 for the U.S. Navy, the anti-submarine aircraft derived from the Electra, has been rolled off the assembly line.

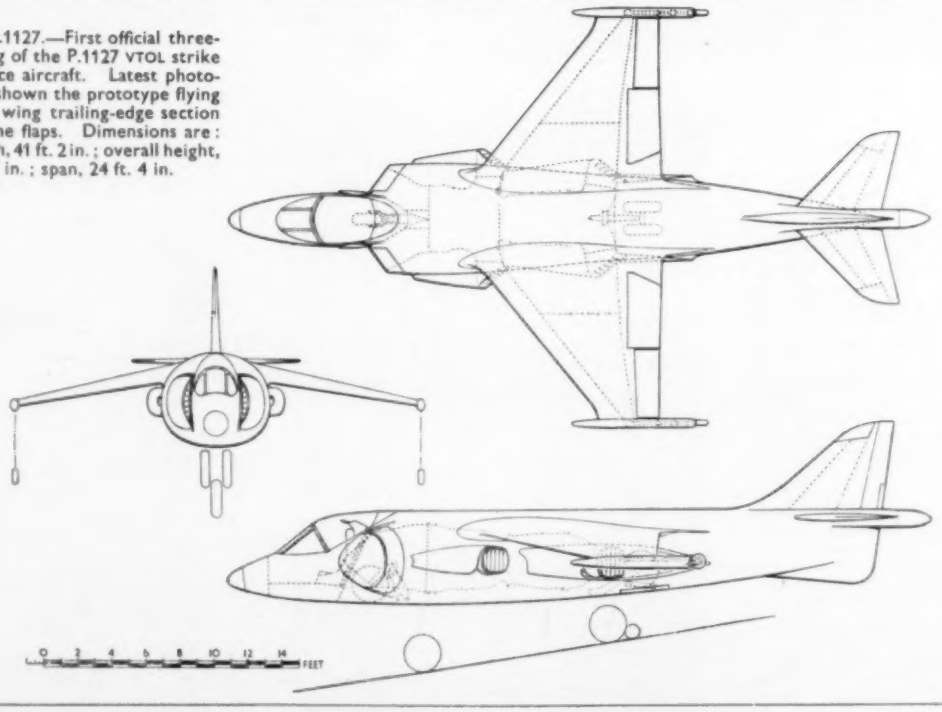
**PRESSURIZED S. BROUSSARD.**—Plans for a pressurized version of the Max Holste Super Broussard were recently completed. Development of this MH. 262 version is to be financed by the S.G.A.C.C. and it will be offered in parallel with the MH. 260.

**BETTER BELL.**—The Bell 47G-3B, which will be marketed commercially in May, has a better performance than any of the earlier 47 series helicopters. It is powered by a Lycoming TVO-435 engine fitted with an AiResearch T-11 exhaust-driven supercharger which gives a 260 h.p. take-off rating.

**POLARIS LAUNCHER.** — U.S.S. "Theodore Roosevelt," the fourth nuclear submarine to be equipped with Polaris SSMs, made its initial test firings of these missiles on Mar. 23.

**REDSTONE TEST.**—A development test of a Mercury-Redstone launching vehicle was made from Cape Canaveral on Mar. 24. Intended to prove certain modifications to the rocket system in the light of earlier Mercury-Redstone flights, the vehicle, which carried a dummy Mercury capsule, reached an altitude of 115 miles and landed 311 miles down-range.

HAWKER P.1127.—First official three-view drawing of the P.1127 VTOL strike reconnaissance aircraft. Latest photographs have shown the prototype flying without the wing trailing-edge section inboard of the flaps. Dimensions are: overall length, 41 ft. 2 in.; overall height, 10 ft. 3 in.; span, 24 ft. 4 in.



**WAITING ON BONN.**—According to reports, the realization of a European heavy satellite launcher based on Blue Streak will depend entirely on the reactions of the German Federal Republic. Italian participation has been made conditional on Germany's agreement, and the Scandinavian countries appear to be holding back until the German position is made known.

**MORE SPACE FUNDS?**—President Kennedy asked Congress on Mar. 28 for authority to spend over $125m. more on America's civilian space programme. He particularly emphasised the importance of developing the Saturn C-2 booster, which would be capable of putting 22-ton payloads in orbit around the Earth, or of sending men on a two-way reconnaissance flight around the Moon.

**RUSSIA'S ASTRONAUT.**—At a Press conference held at the Soviet Academy of Sciences in Moscow on Mar. 28, it was stated that technically a man could have been launched into space last year. Soviet scientists did not consider it necessary to conduct short-range manned ballistic flights as a preliminary to sending a man into orbit. But no man would be sent until 'safety is guaranteed.'

## *Commercial Aviation Affairs*

ECCENTRIC ORBITER. — America's Explorer X, or P-14, satellite which was launched into orbit having an apogee of more than 100,000 miles and a perigee of about 100 miles on Mar. 25. Launched from Cape Canaveral by a Delta rocket, it will study the Earth's magnetic field and the effects of solar plasma.

**A.T.L.B. CHAIRMAN.**—Prof. D. T. Jack, C.B.E., has been appointed chairman of the Air Transport Licensing Board with effect from Apr. 1. Prof. Jack is an economist with a long experience of trade disputes and was chairman of the Court of Inquiry into the London Airport dispute in 1958. He is professor of economics at the University of Durham.

**L.A.P.'s 11,000 ft.**—The extended No. 5 runway at Heathrow was opened to traffic on Mar. 27 (see our issue of Mar. 17, p. 279). The first 1,100 ft. of a fast-turn-off taxiway has been constructed and the runway now has an IATA-approved low-visibility landing light system which provides centre-line guidance throughout the runway length and inset "barettes" for 3,000 ft. at each end. Visual glide-slope indicators have also been installed for use on this runway.

**PILOT FATIGUE.** — The Flying Personnel Research Committee of the Air Ministry is to investigate the work load and working conditions of B.E.A. pilots. This follows the disagreement between BALPA and the Corporation over the latter's summer schedules. The Association has agreed to defer any action until the investigation, which will take about a year, has been completed.

**U.S.-RUSSIA TALKS.** — The U.S. State Department has offered to open talks with Russia this month on a direct commercial airline service between Moscow and New York. The opening of these talks was postponed last July.

**COMETS TO ADEN.**—On Apr. 6 (today), B.O.A.C. is due to operate the first turbojet service between London and Aden. Comet 4s will replace the Britannias previously used and a stop is being made at Cairo instead of Khartoum.

**FOURTH ON ATLANTIC.**—In 1960 K.L.M. retained its position as fourth busiest passenger-carrier over the North Atlantic with a total of 179,000 passengers—or 9.3% of the 1,919,750 passengers carried by IATA member airlines. K.L.M. carried 8,857 tons of freight—or 19% of the IATA total—and ranked third as a North Atlantic cargo carrier.

**AID FOR AIR MALI.**—The Ministry of Aviation has bought three of B.E.A.'s DC-3s at a total cost of £70,000 and made a gift of them to the State of Mali for its new airline.

**A CZECH DISASTER.**—An Ilyushin Il-18 operated by the Czech C.S.A., on a flight from Prague to Bamoko (Mali Republic) crashed near Nuremburg on the night of Mar. 28. All 52 occupants were killed. Preliminary reports spoke of an explosion before the crash, and the possibility of sabotage was being investigated. Il-18s were grounded last year after an Aeroflot aircraft crashed as a result, according to reports, of a wing fire caused by engine combustion chambers burning through.

CABIN COMFORT.— Mockup of the interior of the Boeing Vertol 107-2 as it will be supplied to New York Airways. Seating 25 passengers this type is to enter service during the summer.

## *News About People*

**H.S.A. CONTRACTS.**—New military contracts manager of Hawker Siddeley Aviation, Ltd., is Mr. E. F. T. Jenkins. Apart from war service he has been continuously engaged on contract work in the aircraft industry since 1936. He joined Hawker Aircraft, Ltd., as contracts manager in 1952.

**BALPA'S CHAIRMAN.**—Capt. W. D. Wellwood has been elected chairman of the British Air Line Pilots Association in succession to Capt. D. F. O'Sullivan. Capt. S. L. Arnold-Boakes has been re-elected as vice-chairman. Capt. Wellwood has been an instructor with B.O.A.C.'s Britannia 312 Flight and is now on 707 Fleet conversion. After war-time service in the R.A.F., which included test-flying duties with the R.A.E. at Farnborough, he joined British South American Airways and transferred to B.O.A.C. when the two corporations were amalgamated.

**TEDDINGTON DIRECTOR.** — Mr. V. M. G. Bennett has been appointed to the board of Teddington Aircraft Controls, Ltd. He will be divisional director in charge of sales of the aircraft and bellows divisions. Previously chief executive of the latter division he fills the vacancy caused by the resignation of Mr. J. E. Griffiths.

**CHANGES AT PORTSMOUTH.**—Mr. S. P. Escott, managing director of Portsmouth Aviation, Ltd. since 1957, has become chairman of the company. He succeeds Lt. Col. G. B. Clarke who has retired from this position but continues to be a director. Mr. N. H. Nash, technical director, and Mr. F. Wilkinson, works director, have been appointed joint managing directors.

**NICKEL DIRECTORS.** — Mr. H. W. G. Hignett, managing director of Henry Wiggin and Co., Ltd., and M. Jean M. Dhavernas, have been made directors of The International Nickel Co. (Mond), Ltd.

# Air Transport

## Postponed Free-for-all

AT the eleventh hour the scheduled North Atlantic airlines have agreed, through IATA, to postpone the open-rate cargo situation by retaining existing rates until Jne. 30. These were due to expire on Apr. 9 and most of the airlines had announced their own proposed rates for Apr. 10 onwards. The date of the resumed IATA traffic conference has yet to be announced.

The probability of agreement on scheduled-service Atlantic cargo rates will be greeted with what are usually known as mixed feelings by shippers, consignees and airlines. A free-for-all, with widely differing rate structures, would have been a confusing situation—but one which was likely to give the air-freight business a necessary fillip. A truce was probably inevitable once the U.S. Civil Aeronautics Board had required the three American airlines (see last week's issue, p. 337) to submit a common tariff.

## And Now Nigeria

IN spite of earlier beliefs that the independence of the Federation of Nigeria (since Oct. 1, 1960) would not change the status of Nigeria Airways, this is, after all, to become a wholly national carrier. Elder Dempster Lines and B.O.A.C. have now offered to dispose of their shareholdings to the Nigerian Government and this offer has been accepted.

Since October, 1958, Nigeria Airways has been operated by WAAC (Nigeria), Ltd., in which the Nigerian Government has held 51%, Elder Dempster 32½% and B.O.A.C. 16½% of the shares. The company was formed after the independence of Ghana and the break-up of the original West African Airways Corporation. B.O.A.C. has been operating long-haul services with Britannias on lease, while local services have been operated with DC-3s, seven of them owned by Nigeria Airways and three, more recently, on short-term charter from B.E.A.

## B.O.A.C. and Self-insurance

THE trend nowadays seems to be for airlines to try to carry at least a part of their own aircraft insurance so that the inevitably high (and rising) premiums can be kept as low as is reasonably possible. In previous years B.E.A., for instance, has carried all its own ground risks, and this year the corporation is carrying 75% of its flight-risk insurance.

B.O.A.C. has now gone so far in the self-insurance business as to decide that, though the Boeing 707s and Comet 4s must continue to carry full normal insurance, the risks on the remainder of the fleets (all propeller-driven aircraft) could sensibly be carried by the corporation itself. Its brokers were accordingly asked to obtain the best terms they could for the turbojet fleets.

The premiums on a fleet of the size of B.O.A.C.'s obviously add up to a sizeable sum. In the corporation's 1959-60 report and accounts a figure of £2,567,580 appears under the heading of "fleet insurance" and this amounted to something like 4% of the total fleet assets, less amortization.

This partial self-insurance is the kind of compromise which might have been expected. The complete loss of a long-haul turbojet will involve a replacement value of £2 million or more for the aircraft alone, and a relatively minor accident —such as that involving the 707 which ran off the runway at London Airport last December—can nowadays cost something like £500,000. In addition, there are passenger and third-party risks to be covered and a major disaster could cost the underwriters a great deal more than the £2½ million or so which has been paid annually in premiums by the corporation.

## Board Decisions

LICENCES have been granted by the Air Transport Licensing Board in respect of the nine applications heard at the first two public hearings (see our issue for Mar. 23, p. 313). The licences are for eight inclusive tour services by Air Safaris and one by East Anglian Flying Services, and they have been granted as applied for with only one very minor exception. The objectors who appeared before the Board at the hearings have therefore been unsuccessful.

The latest issue of Civil Aviation Licensing Notices contains news of several new applications for scheduled services by independent operators. These include a series of applications from Overseas Aviation, in which the use of Argonaut, Ambassador, Viking and Heron aircraft is specified initially, and Viscount 800, Vanguard and Trident later. The routes concerned are Jersey-Birmingham-Newcastle; Jersey-Manchester-Glasgow; Jersey-Bristol-Liverpool; Edinburgh/Glasgow-Newcastle-London; London-Jersey; Prestwick-Belfast; Jersey-Cardiff-Dublin; and Belfast-Liverpool-Tarbes.

Among the new applicants for inclusive tour services are Trans European Aviation, Ltd., and Falcon Airways, both using Constellation L-049Es. Westpoint Aviation has withdrawn its application for an internal tour service to Exeter (see our issue for Jan. 27, p. 87).

## Accidents—A Better Quarter

ALTHOUGH a three-month period is too short to be used as an indication of overall trends, it is encouraging to record a marked improvement in the fatality rate in transport aircraft in the first quarter of 1961. A preliminary survey indicates that 173 passengers were killed on scheduled airline operations, or exactly half the total in the first quarter of 1960. The comparative fatality statistics are as follows:—

| | Jan.-Mar. 1961 | Jan.-Mar. 1960 |
|---|---|---|
| Scheduled operations:— | | |
| Passengers .. .. .. .. | 173 | 346 |
| Crew .. .. .. .. .. | 39 | 42 |
| Non-scheduled and training:— | | |
| Passengers .. .. .. .. | 3 | 4 |
| Crew .. .. .. .. .. | 21 | 10 |

The unhappiest aspect of the 1961 record to date is that it has included the first major accidents to the DC-8 and Boeing 707 in regular service. In the Aeronaves DC-8 take-off accident

(*Continued on page 365*)

TEUTONIC PAIR.—Seen together for the first time in this new air-to-air study are the largest and smallest members of the Boeing jet family—the Conway-engined 707-420 (nearest the camera) and the JT3D turbofan-engined 720. Both these aircraft are for Lufthansa, which has also ordered the Boeing 727.

# Jack Milligan buys a business plane

*(Sales Director, Layton-Ross (Overseas) Ltd)*

The Board took a bit of persuading, but J.M. had figures to back him. Look, he told them, we've a factory in South Wales and another on Clydeside, we've associates in Turin, Zurich, Dusseldorf, we've suppliers in Israel, Turkey, Iran. As for our clients, they're everywhere you can think of. With our executives spending most of their time shuttling to and fro between one and the other, this new plane will be an economy, not a luxury.

But why, one of the directors wanted to know, did J.M. propose they should buy it through UDT? Jack explained: it's the most convenient way. The purchase becomes a simple entry in the accounts, with only a small need for any capital outlay. A sensible way of doing things, the Board agreed.

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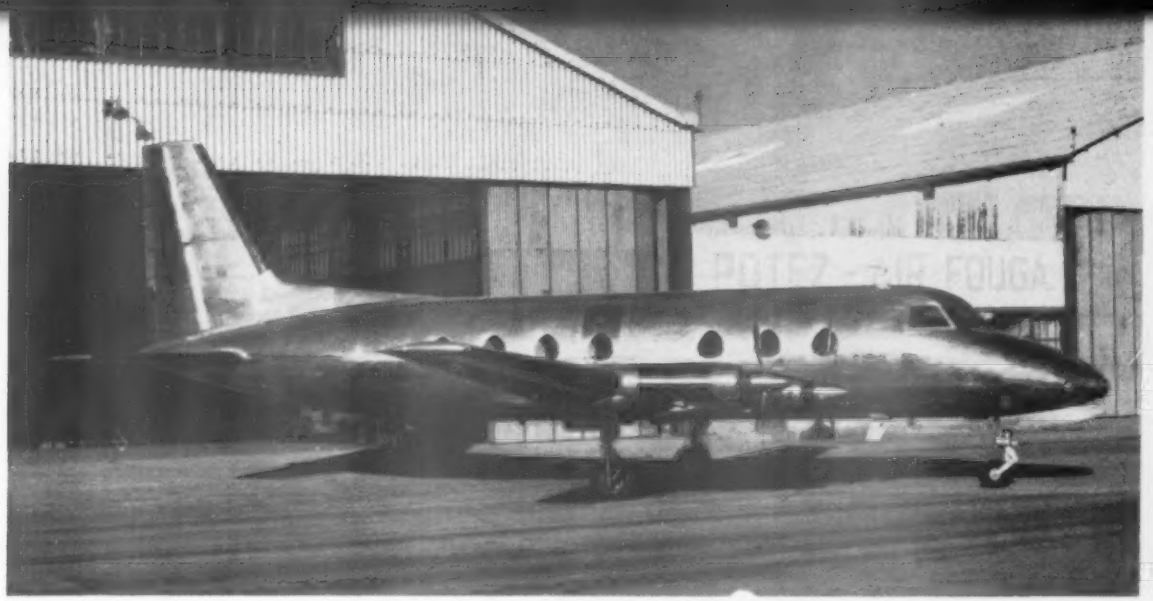


POTEZ PROTOTYPE.—Ready to begin its flight trials at Toulouse, the Potez 840 (see our issue for Mar. 23) is an attractive 16-seat French feederliner with four Astazou turboprops.

## *Air Transport . . . .*

(*Continued from page 364*)

at Idlewild on Jan. 19, no passengers were killed, but the crash of a Sabena Boeing 707 on Feb. 15 near Brussels cost the lives of all on board—61 passengers and the crew of 11. Another Boeing 707 was destroyed on an American Airlines' training flight on Jan. 28, with the loss of the crew of six. The reasons for the Aeronaves and Sabena accidents have still to be established, but it appears that the American Airlines' Boeing shed one or more engine pods in an over-violent manœuvre.

The Sabena crash was the worst of the quarter. Others involving passenger fatalities on scheduled operations included a Finnair DC-3 on Jan. 3, two Garuda Indonesian DC-3s, on Jan. 24 and Feb. 3, an L.A.V. DC-3 in Venezuela on Mar. 10 and a C.S.A. Il-18 on Mar. 28.

Several non-fatal accidents also made the headlines in the first quarter. Of these, the most spectacular was the B.O.A.C. Comet 4 which brushed trees on high ground when off-course during an approach to Fiumicino, Rome, on Jan. 25. Three Boeing 707s were damaged in landing incidents, of which the most serious was a ground loop by a Braniff aircraft at Houston on Feb. 25 following a reported undercarriage failure. Slight damage was suffered by an Air France 707 at Orly on Jan. 3 and a South African 707 at Kloten, Zurich, on Jan. 31, both of which overran the runway; the latter was the same aircraft which had been more severely damaged at Nairobi on Oct. 30, 1960.

Three piston-engined airliners were completely destroyed in non-fatal accidents during March, two of them by fire. The first of these incidents was on Mar. 6, when an Iberia L-1049E Super Constellation hit a wall at the end of the runway at Sao Paulo; the undercarriage was damaged and the aircraft caught fire on landing, but all passengers and crew left without injury. On Mar. 20, a Seven Seas DC-4 on a charter flight from Bombay to Bangkok suffered a total power loss and was damaged beyond repair in a forced landing near Nagpur. The crew of five escaped. In a touch-and-go landing at Shannon on Mar. 26, a Cunard Eagle DC-6C crashed and caught fire; the crew of six escaped.

## Attracting the Mass Market

SOME idea of the fares which could be economically charged by airlines when using written-down, but still reasonably modern, piston-engined aircraft can be gained from two recent offers of group travel facilities between Europe and the U.S.A.

Three weeks ago (see our issue of Mar. 23, p. 312) Saturn Airways, a U.S. certificated supplemental carrier, advertised a one-way fare, Europe-U.S.A., of £29 3s. 6d. for each of 90 passengers in a DC-6B.

Now Flying Tiger Line is offering U.K./Europe-New York flights at a return fare of £35 8s. based on 118 passengers in L-1049s. This fare will apply from any airport in the U.K. which is operationally suitable for Super Constellations, and from Paris, Brussels, or Amsterdam.

Admittedly, this passenger load will involve very high-density seating arrangements, but the fare includes free hot meals in flight and, more important, an allowance of 50 lb. of baggage per passenger. At this level of fare nobody is going to complain too vigorously about lack of leg-room or elbow-room.

Scheduled carriers will rightly say that it is easy enough to do better than to make ends meet on infrequent services which require no expensive and permanent organization and which are operated at 100% load factors. But Flying Tiger is offering return fares of less than £70 even for parties of 60 (a 51% load factor). There is something more than a little odd about the situation when it is remembered that the lowest London-New York return fare (for a 17-day excursion) by IATA scheduled airline is £114 6s.

The flights are to be operated under the U.S. and U.K. regulations governing group travel, whereby the organization concerned must have a purpose other than that of securing cheap travel (and must not, generally speaking, have a membership in excess of 20,000) and the travellers must have been members of the group organization for at least six months prior to the flight

## Air Safaris Plans

POSITIVE interest in the Handley Page Herald was shown by Air Safaris this week when a group of the company's executives flew from Hurn to Sandown, I.o.W., in the Handley Page demonstrator. It was being flown by Air Safaris' senior pilot and director, Capt. C. M. de Bounevialle, D.F.C. The company has a licence to operate up to eight flights a week on the route Sandown-Birmingham-Newcastle with an optional stop at Hurn; de Havilland Herons will be used for this service at first, and the Herald is being evaluated as possible new equipment for this and other routes.

Air Safaris is to open its first scheduled passenger service on Apr. 8, from Hurn to Amsterdam and Ostend. Two flights a week will be operated with 36-seat Vikings, including one cheap night flight on Saturdays. On Apr. 16, a twice-weekly service on the route Hurn-Dublin-Belfast will be inaugurated, and on Jne. 3 services from Hurn to Exeter and to Birmingham and Newcastle will begin.

For the 1961 season, Air Safaris has designed a new colour scheme for its fleet, which includes Hermes as well as Vikings and Herons, with the "A.S." motif prominently displayed on a dark green fin.

## Airport Activity, 1960

AN increase of 28% in the number of passengers handled at U.K. airports in 1960 over the 1959 total is shown by the latest Ministry statistics. Freight short tons increased by 24%, but the number of aircraft movements was only 12% more than in the previous year.

The growth in activities at London (Heathrow) was greater than these nation-wide averages, being 14% for movements and 31% for passengers. As a result of the closing of Blackbushe and Croydon, the total activities at London area airports was, however, a little below the average. In specific numbers, London (Heathrow) handled 146,506 movements in 1960 (of which all but 11,000 were air transport) and 5,380,937 passengers (including 6,966 in transit). Gatwick had 35,848 movements in 1960 (of which 19,593 were air transport) and handled 475,020 passengers (including 5,343 in transit). The Gatwick total represented an increase of more than 50% in movements and nearly 30% in passengers.

Among other airports with large increases in the number of passengers were Stansted, where the total rose from 17,353 to 59,634 as a result of B.U.A. trooping activities; Southend, up 76%; Birmingham, 50%; Edinburgh, 44%; Manchester, 33%; Belfast, 32%; and Liverpool, 31%.

RADAR TRAINING.—The simulation room at International Aeradio's School of Air Traffic Control, showing one of the aerodrome/approach control desks and two surveillance radar consoles.

## *Air Transport* . . . .

### Surveillance Radar Training

TWO courses in surveillance radar training have recently been introduced by International Aeradio at its School of Air Traffic Control at Southall. Approved by M.o.A., they cover the work of either approach or area control radar.

The first course is designed for students with little or no previous radar-control experience and lasts for seven weeks. The first two weeks are made up of lectures in radar theory and operating techniques, and the remaining weeks are spent in practical training on a Redifon Type C.835 radar trainer.

Intended for A.T.C. radar controllers who have had considerable practical experience, but require further refresher training on the theoretical aspects of radar, the second course is of approximately three weeks' duration. The first two weeks cover the same lecture syllabus as that for the longer course, and the third week is devoted to simulator training.

This second, mainly theoretical, course has been created to meet the new M.o.A. requirement that all radar controllers in the United Kingdom must obtain a licence and a traffic director (approach) radar rating by August, 1962.

### B.E.A. in February

A RECORD number of passengers—202,063—were carried by B.E.A. in February. This is the "trough month" of the Corporation's year and the total is 18% more than that for February, 1960. Passenger-miles, at 69.34 million, showed a 17.2% increase.

| | February 1961 | February 1960 | Variation |
|---|---|---|---|
| Capacity ton-miles offered | 14,461,000 | 11,736,000 | +23.2% |
| Load ton-miles sold | 8,309,000 | 7,513,000 | +10.6% |
| Revenue load factor | 57.5% | 64.0% | −10.2% |
| Passengers carried | 202,063 | 171,275 | +18.0% |
| Passenger-miles flown | 69,340,000 | 59,175,000 | +17.2% |
| Passenger load factor | 57.3% | 61.6% | − 7.0% |
| Freight ton-miles | 1,254,600 | 1,310,500 | −4.3% |
| Mail ton-miles | 317,900 | 308,800 | + 2.9% |
| Aircraft miles flown | 2,312,000 | 2,253,000 | + 2.6% |
| Revenue hours flown | 11,299 | 11,620 | −2.8% |

Needless to say, these passenger and passenger-mile totals are small by comparison with those for the peak months. In August, 1960, for instance, the passenger total was 525,112 and the passenger-mile total was 180,975,000—158% and 161% respectively greater than the record figures for February, 1961.

# Approach Lighting in Russia

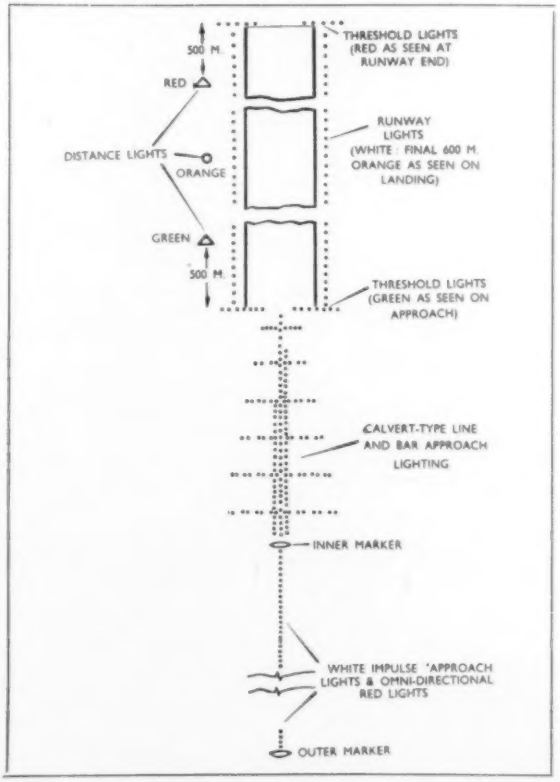
ALTHOUGH neon approach and threshold lights have been adequate for use by Aeroflot's Il-14s in visibilities down to 330 yd. something much better was required for operations with Tu-104s and Il-18s. The floodlighting of the runway threshold and the use of runway distance markers (green 1,650 ft. from the threshold, orange at the half-way point, and red 1,650 ft. from the end) have been tried, but these, by themselves, were not found to be adequate.

An approach-lighting system which appears to combine the advantages of sequenced flashing lights (as at New York's Idlewild) and the Calvert-type line and crossbar system has now been developed, and this new lighting has been installed at Moscow's Vnukovo Airport. The equipment is of Soviet design and manufacture and differs from other layouts in the use of impulse flashing lights between the outer and inner marker beacons. These lights are designed to give visual assistance to the jet pilot, even in poor visibility, as he comes in to the approach 8-9 miles from the runway threshold or 5-6 miles from the outer marker.

At the outer marker four powerful white impulse lights are spread over a distance of 1,300 ft. Towards the inner marker there is a second, longer series of impulse lights of lower power. They flash 45 times a minute and have two degrees of brightness.

Between the inner marker and the runway there are red centre-line lights which are arranged in triple-, double- and single-row groups along the approach axis. Across these are six series of horizon bars which are formed of projector lights with orange filters. Similar lights are installed at the edge of the safety zone where the flare-out is started. Red boundary lights are installed at the edges of the safety zone and the threshold of the runway is marked with two lines of green entry lights.

The white runway lights, which are placed 165 ft. apart, are conventional in that for the final 2,000 ft. of the runway, in each direction, they are orange as seen on the approach and landing. The line-and-bar approach-lighting system has five degrees of brightness and the runway lights have seven degrees of brightness.

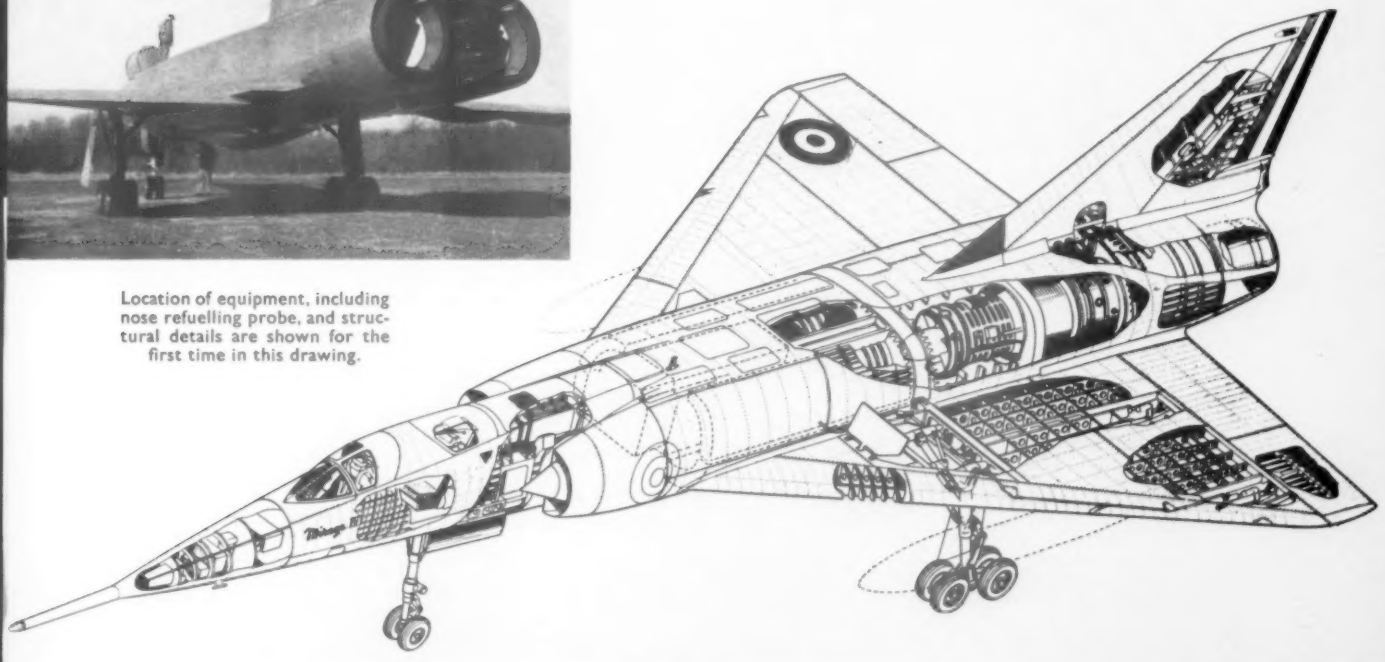

500 M.
RED
DISTANCE LIGHTS
ORANGE
GREEN
500 M.
THRESHOLD LIGHTS (RED AS SEEN AT RUNWAY END)
RUNWAY LIGHTS (WHITE: FINAL 600 M. ORANGE AS SEEN ON LANDING)
THRESHOLD LIGHTS (GREEN AS SEEN ON APPROACH)
CALVERT-TYPE LINE AND BAR APPROACH LIGHTING
INNER MARKER
WHITE IMPULSE APPROACH LIGHTS & OMNI-DIRECTIONAL RED LIGHTS
OUTER MARKER

On the right is a sketch plan showing the general layout of the approach and runway lighting at Vnukovo Airport.

# Mach Two Striking Power

*Due in service by* 1964, *the M=2 Dassault Mirage IV bomber has emerged, after completion of aerodynamic trials, with full operational equipment for tactical development.*

Above, the crew of two are seated in tandem Martin-Baker ejection-seats. Left, the twin tailpipes of the Atar 9D afterburning turbojets are separated by a knife-edge fairing. Also visible are the newly added ventral radar bulges, seen again in the bottom picture with the plastic panel for the nose radar and the external pipe runs.



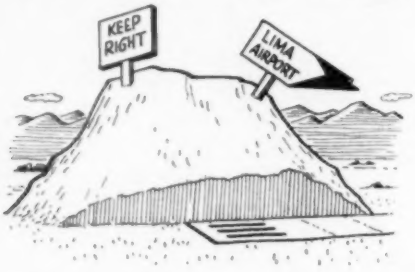
Location of equipment, including nose refuelling probe, and structural details are shown for the first time in this drawing.

# Peruving Flight to Lima

by Wren

NOT many people are lucky enough to be either wealthy or journalists, so I am prepared to accept that there are those among you who have yet to wake up one morning in England with the knowledge that on the following morning you will be breakfasting in Peru. It will be possible from Apr. 11 when B.O.A.C. reopen the London-Lima service which, with their other South American services, they had to close down nearly ten years ago because of the withdrawal of the Comet 1s. For six years the South American continent had no scheduled British services, until B.O.A.C.'s Comet 4s reopened the old route, which B.S.A.A. had pioneered, from London to Recife, Rio de Janeiro, Sao Paulo, Montevideo and Buenos Aires on the east coast, and across to Santiago.

With the approach of the end of the 10-year period, during which B.O.A.C. had to operate a scheduled service into Lima or lose the right to do so, the corporation decided that the




prospects and portents justified its resumption. The reopened service will be twice weekly via New York and Nassau, the 707 taking about 18 hours in each direction.

It seems most unlikely that any substantial tourist traffic can be counted on. Indeed, the Peruvians themselves seem to have little desire to stimulate British tourist interest for they could not produce even a map of Peru when I called at their London Consulate for my 28s. visa.

Through passengers from London are likely to be mostly business men but travellers to Nassau should help to fill the 129 seats offered. B.O.A.C. are hoping that the fast and more direct service between New York and Lima, and their superior cabin service, which is the despair of American airlines, will attract American custom away from Panagra and Braniff. Two nice touches—multi-lingual Chilean stewardesses are carried, and the departure from Lima will be at a time during the morning which families and friends will find more convenient than the 00.55 hr. departure time of Panagra's DC-8s. On the other hand, Panagra's service is daily.

First-class return fare, London-Lima, is £543 5s., economy £350 8s., prices which are, according to a legend on B.O.A.C.'s book matches, "Cheaper Than You Think." Alas, they are also dearer than most of us can afford, so the next best thing is to be a journalist on a proving flight.

The purpose of a proving flight is, broadly, to try out the facilities, in the air and on the ground, on which the service's efficiency, safety, comfort and punctuality depend, and to familiarize air and ground staff with those facilities. Readers not directly in touch with this sort of operation like to know these things, they tell me, so you may also be interested in a list of the 50 or so people who assembled at London Airport on Mar. 21 to fly to Lima, under the overall command of Capt. Tom Nisbet, B.O.A.C.'s 707 Fleet Flight Manager:—

> 11 captains, 3 first officers, 1 nav. officer, 2 engnr. officers, 7 stewards, 8 stewardesses, technical manager, engineering manager, asst. personnel manager, 707 flight simulator supt., 707 project engineer, navigating supt., traffic inspector, flight services supt. N. America, 2 catering officers, 4 Rolls-Royce engineers, 1 Boeing engineer, 2 B.O.A.C. Press officers, B.O.A.C.'s chief photographer, the B.B.C. Overseas Dept.'s Peruvian representative, and 4 journalists.

With the fuel tanks, the galleys, the flight deck, and the 32 first-class seats all full up, plus an overflow in some of the economy-cabin's 97 seats, G-APFI weighed 282,000 lb. for take-off. I suppose 45 seconds doesn't *sound* very long, but it sure *seems* a long time to keep rolling, until the 707 sweeps steeply up to a thousand feet or so over the boundary when, to soothe the local residents (and de-soothe the occupants aft of the flight deck) the power and noise are reduced until height and distance are gained.

Because the crews all know New York's Idlewild procedures, we give it a miss and head for Bermuda.

Poised stationary, it seems, at about 35,000 ft., we are nevertheless cutting along at 480 knots as we amble about and talk and lunch. The engineer types visit the flight deck from time to time to take readings and we question our Peruvian friend on his country. Population 10 million, a million of them in Lima, the capital, which has a humid and peculiar climate—only two seasons: one when there is a perpetual overcast, the other when there isn't. And it never rains. The coinage is simple—the sol, 75 to the £ and so worth about 3d., and the centavo.

Peru has built-in wealth and resources, if only they could get the stuff out. The Americans have a large foot in the door, with the Japanese and Germans closing up behind, and the British trying hard to improve their long-standing friendly association with Peru. South America has its own Common Market to strengthen its bargaining hand, and in October it is holding its Pacific Fair in Lima.

At Lima's Callao International Airport—the B.O.A.C. 707 and two Panagra aircraft, a DC-8 and DC-7.

The hill alongside the north-west approach to Lima's Callao International Airport.

The 3,100 miles to Bermuda were covered in just 7 hr. Although this is British territory, the tourists from the U.S.A. have Americanized the hotels and beaches, and Kindley Field is under almost totally American military control, due, I was told, to an official British oversight in the wording of the agreement between the two countries. However, the 99-year lease has only another 79 years to go.

As Nassau is also familiar to B.O.A.C. crews, we used it only as a turning point and for a procedural refresher in the next day's flight from Bermuda to Lima. Passing over Ecuador and the Equator (so *that's* how the country got its name) we were told by some far-away air traffic controller to descend to the regulation height of 11,500 ft. imposed on aircraft flying over that country, but while the conversation was to-ing and fro-ing, we'd passed on to Peru.

Pathfinders all — Captains Frank Taylor, Ken Loveless, Douglas Cracknell, and Derek Walbourn were pilots in the Pathfinder Force, later flew with B.S.A.A. on the South American routes.

The old Lima airport, Limatambo, built in 1948, had the advantage of being only three miles from the city, but the disadvantage of being at 4,000 ft.—which put it in the murk too often—and limiting runways and surroundings. So now it handles only domestic traffic, while a new airport with an 11,000-ft. runway has been built at Callao, nine miles west of Lima. The new airport has limited radio and radar facilities so far and the passenger handling is done in what will be the freight section when the ultra-modern passenger terminal has been built in two years or so. Our pilots looked askance at a large hill just off the north-west approach.

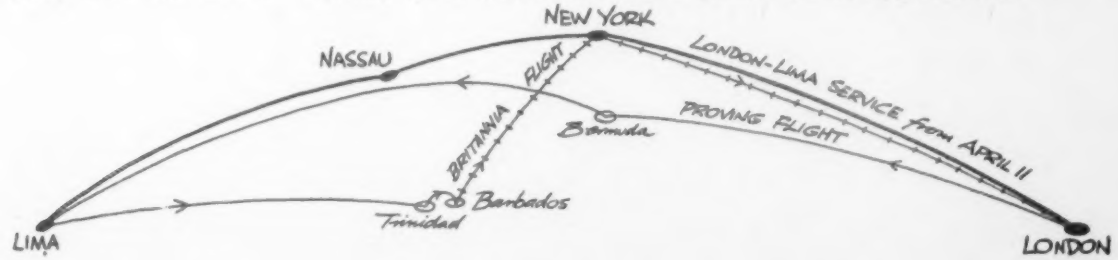
Peru was the last South American country to gain independence from the Spaniards and the Spanish influence in its character and architecture is marked. For the tourist there is also exotic vegetation, sandy beaches and exciting mountain motoring to old Inca ruins, and a journey by the World's highest railway to 15,000 ft. across the Andes. British is spoken in many shops and we seem to get on pretty well in our dealings with Peru.

The Peruvian Air Force, although modest in size, is equipped with Hunters and Canberras, and while Peru has not actually ordered the Comet, the beating of its wings can be heard. There is a thriving Lima branch of the R.A.F. Association with no fewer than 60 members, contributing much to British prestige and sociability.

The 707 gave two demonstration flights during its stay in Lima, one of which left its mark on a local Pressman, who reported the consumption during the flight of 50 bottles of whisky, champagne and cognac. The Press are the same the World over.

From Lima, the 707 flew across the top of South America to Trinidad, where we found Mr. Macmillan's R.A.F. Comet parked in the pouring tropical rain. Picking up some local B.O.A.C. staff, we followed what was almost a missile trajectory to cover the 180 miles to Barbados—up to 24,000, levelling out for seven minutes, and then descending to spend our last night with the proving party. They were staying on to do more familiarization work in the area, while we privileged guests took to a Britannia service to drone home by way of the Idlewild shambles.

The speed and well-being of air travel is proved and established—in the air. Now something must be done about air travel on the ground. And lowering those fares.



# Testing to Mach 5

INTENDED for speeds between Mach 2.5 and 5, the new high supersonic speed wind-tunnel at the Royal Aircraft Establishment, Bedford, is a very important addition to Britain's aerodynamic research facilities. A continuous-running tunnel, it has a working section 3 ft. wide and 4 ft. high. Both the tunnel pressure and temperature can be varied during long-duration test runs and very high Reynolds numbers can be achieved in the working section; in certain cases full-scale flight Reynolds numbers can be achieved.

Design of the tunnel began early in 1955 and it was first operated at supersonic speed in August last year. Initially it is being run with fixed nozzle liners, giving a constant speed of Mach 4 in the working section, but its variable nozzle will be installed in 18 months' time. This will allow tests to be made between the design Mach numbers of 2.5 and 5.

The tunnel will be used for general research programmes providing data for missiles and aircraft which will be operated up to and beyond Mach 5; few specific projects are likely to be tested in the near future. It will supplement the work which can be done with the 8-ft. by 8-ft. Bedford tunnel, which is used for tests between subsonic speeds and Mach 2.8. The same models can be tested in both tunnels.

Total power input to the new tunnel's compressors is limited to 88,000 h.p. to match existing power supplies at the R.A.E., Bedford. Two sets of compressors are used. The two units in each set are operated in series to give the high pressure ratio and lower-volume flow for the higher Mach numbers, and in parallel to give the high-volume flow and lower pressure ratio necessary at lower speeds.

Inlet total pressures in the tunnel can be raised to 12 atmospheres at Mach 5, and air temperatures increased to 150° C. to avoid liquefaction effects during expansion to supersonic speed. During a tunnel run the temperature can be varied over a range of 100° C.

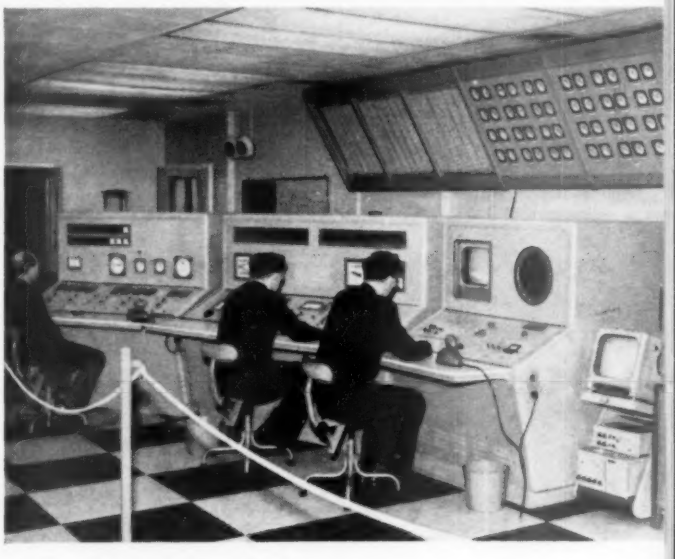
Tunnel air has to be very dry to avoid condensation in the working section; the requirement is a dewpoint below −50° F., equivalent to less than 0.00005 lb. of water per lb. of air. Dry air is stored at 4,500 p.s.i. To increase tunnel pressure it can be admitted at a rate which is limited only by the increase in power demand, which is restricted to 10 MW per minute.

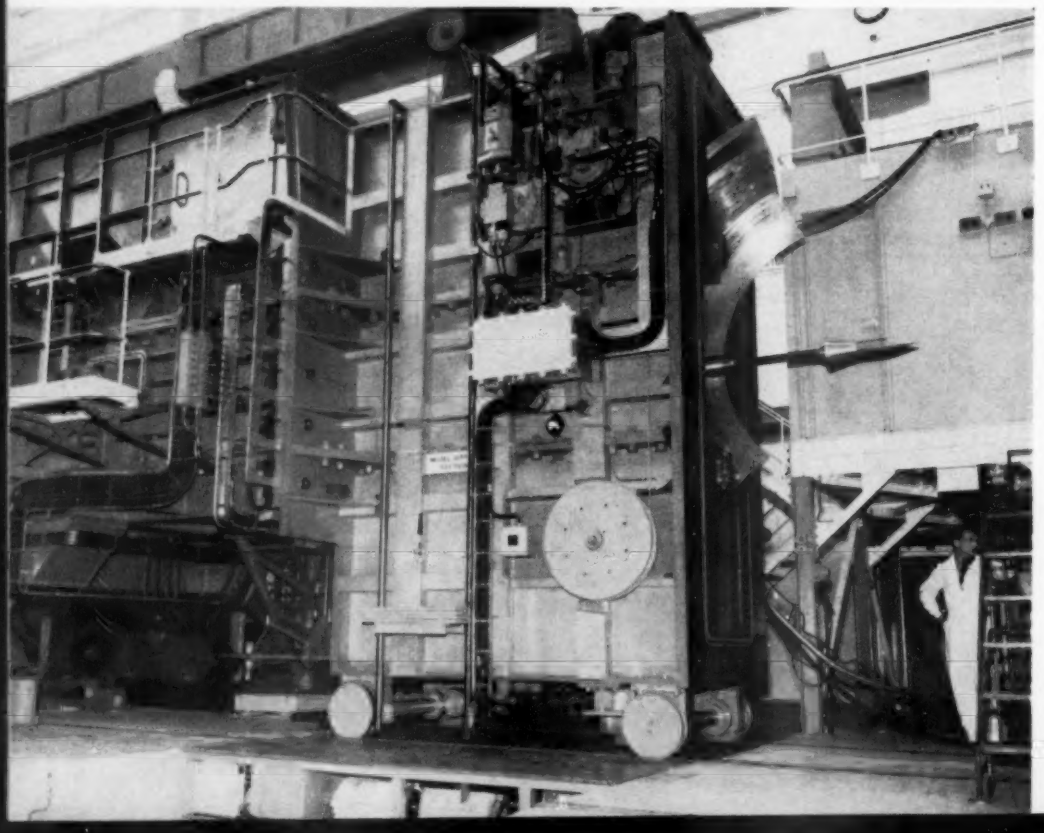
After the compressors have been run up to speed, the operation of the tunnel can be controlled completely from the observation room. In this room the model under test can be observed and test results recorded. Force and pressure readings are recorded in punched-card form for analysis by computer as well as on strip-chart recorders.

Air entering the tunnel is expanded into the settling chamber, a cylindrical pressure vessel of about 11 ft. diameter, with an inner fairing forming a cylindrical surface 9½ ft. in diameter. Five screens of stainless steel wire smooth out fluctuations in the airflow, which has a velocity in this region of about 100 f.p.s.

The contraction fairing progressively reduces the passage shape from a circle of 9½ ft. diameter to a rectangle which forms the throat of the nozzle. The fixed nozzle at present fitted has a throat 3 ft. wide and 4 inches high. At its downstream end the nozzle is 3 ft. wide by 4 ft. high, forming the test section of the tunnel.

The flexible nozzle to be fitted later will have fixed-shape

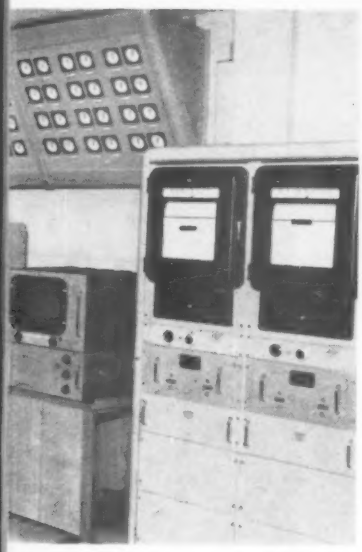




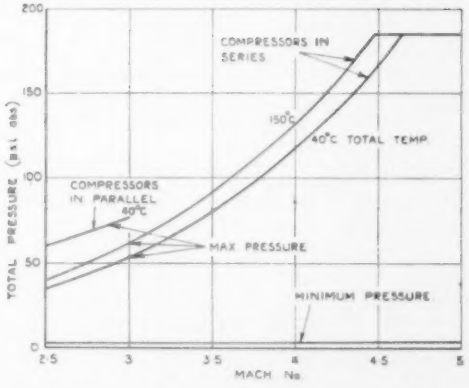
MODEL TROLLEY.—When the tunnel is opened the model-support section and diffusers are rolled 11 ft. downstream until the model section is on its transporter, as seen here. This section can then be moved out sideways and replaced by another on which a new model has already been set up.

POWER.—Right, in the compressor hall of the tunnel there are two identical compressor sets, each driven by a 34,000-h.p. synchronous motor and a 10,000-h.p. induction motor.

*Photographs copyright "The Aeroplane and Astronautics"*



CONTROL ROOM.—Left, the chief test controller views the model under test via closed-circuit television. The circular panel is a Schlieren screen showing the shockwave pattern round the model.




PRESSURE RANGE.—Total pressure available for model testing over the Mach number range of the tunnel.

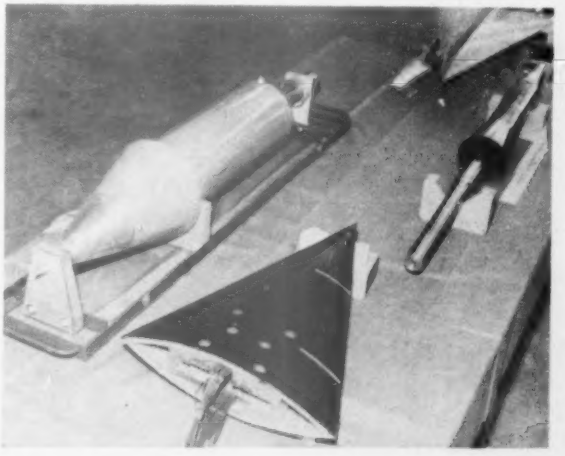
throat blocks and flexible steel plates the contours of which are adjusted by 17 electric jacks. The Mach number will be changed by moving the throat blocks in or out and it will be possible in this way to vary the Mach number from 2.5 to 5 while the tunnel is running.

A number of interchangeable model support sections are to be provided. This section is withdrawn from the tunnel by unlocking its upstream flange and the flange which follows the second corner at the downstream end of the tunnel. This part of the tunnel is then withdrawn about 11 ft. to move the model-support section onto a transporter; this is moved into the rigging bay and replaced by another section with the next model.

Each model-support section has a model mounted on a quadrant and sting and provides for an incidence range of $-5°$ to $+27°$ and a roll-angle range of $\pm 180°$. Pressure tubes, strain gauge wires and thermocouple wires from the model are taken out through the support sting and quadrant to the recording apparatus.

Downstream of the model-support section is the supersonic diffuser and immediately following this is a long transition section, the subsonic diffuser, which changes the tunnel cross-section from 4 ft. by 3 ft. to 7 ft. diameter. It contains a safety catch-net at its downstream end.

Design and construction of the tunnel were by Ministry of Works engineers and architects, Ministry of Aviation scientists and engineers and a range of industrial contractors and sub-contractors. Leading contractors were Associated Electrical Industries, Ltd., who supplied main compressors, motors, gears, coolers and control equipment, and the General Electric Co., Ltd., who were responsible for the working-section leg of the tunnel and the controls and instrumentation for this section.

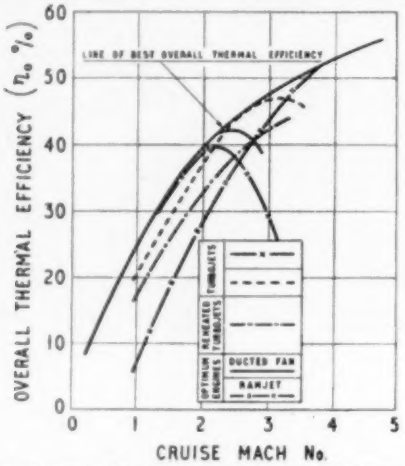


TEST MODELS.—These are typical of models to be tested in the tunnel. They are: (left) a model for heat-transfer tests; (centre) two slim delta wings; and (right) a missile research model.

# Supersonic Possibilities—the B.A.C. View

DR. A. E. RUSSELL, *technical director of Bristol Aircraft, Ltd., and head of the British Aircraft Corporation team which holds the M.o.A. design study contract for the supersonic airliner project, recently lectured the Guild of Air Pilots and Air Navigators on supersonic transport aircraft.*

OPENING his lecture, Dr. Russell said that the prospect of a supersonic transport had awaited aerodynamic advances and the awakening of interest by an authority able to find large sums of money. Judgment in some unexpected places (i.e., the United States) seemed to be dominated by over-emphasis on the merits of the highest conceivable speed.



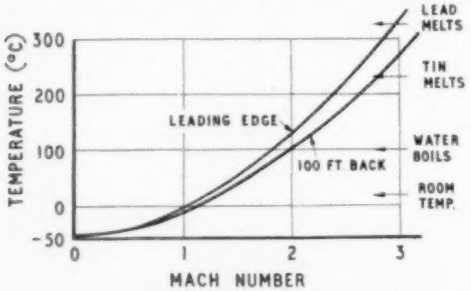

ENGINE EFFICIENCY.—Overall thermal efficiency of powerplants plotted against Mach number.

Many on the British side were puzzled by a strong indication that the U.S. was advocating a cruising speed around Mach 3, whereas a less ambitious speed seems to offer a considerably better chance of approaching typical costs in current airline operation.

He went on to discuss general problems of supersonic aircraft and how they could be overcome; for example, the reduction in lift/drag ratio at supersonic speeds which was counterbalanced by an improvement in propulsive efficiency. He also discussed the effect of aerodynamic heating. At Mach 2.2 the structure reaches a temperature of 120° C. away from the leading edges, permitting the use of aluminium alloys in all except critical regions. But when cruising at 70,000 ft. and Mach 3 the structure reaches 275° C., demanding a complete switch to stainless steel or titanium.

Discussing the choice of engines, Dr. Russell concluded that at both Mach 2.2 and 3 the turbofan has advantages over the turbojet; these advantages depend on noise limitations and the fact that about half the aircraft's fuel is consumed at speeds below the cruising speed.

Comparing aircraft for these two speed ranges, the Mach 2.2 type can have a narrow delta wing with sufficient thickness and volume to contain the fuel and main undercarriage. Wing loading would be chosen to allow a close approach to the maximum lift/drag ratio when cruising at around 60,000 ft. If a free exchange of heat from the wing surface to fuel is prevented, the fuel can act as the main heat sink for the air-conditioning system.



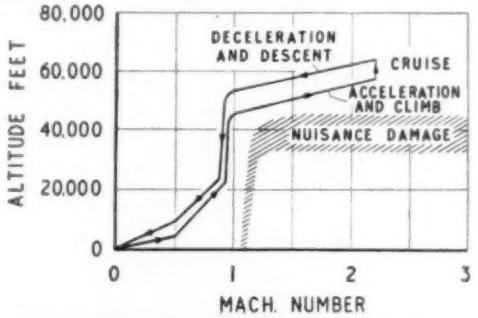

KINETIC HEATING.—Variation of airframe surface temperature with Mach number.

The narrow delta wing of the Mach 2.2 aircraft is unsuitable for much higher speeds, because greater sweep would lead to a very low aspect ratio. Without complex auxiliary devices, excessive wing area is then needed for acceptable approach speeds and also very high installed thrust is necessary to fly close to the maximum lift/drag ratio.

Research and analysis have not yet reached the point where the best aircraft configuration can be chosen for a Mach 3 airliner. A canard layout is most generally favoured, with a very thin main delta wing of moderate sweep. Much of the fuel must be stowed in the fuselage. The necessary stainless steel or titanium structure is likely to be heavier.

Problems in the aircraft systems also increase in severity as the temperature rises with increasing speed.

An example is the air-conditioning system. For the Mach 2 aircraft the air supply from the main engines can be cooled by using the fuel as a heat sink. The combined heat input to the fuel from the heat exchangers and from surface conduction is just tolerable, allowing virtually conventional stowage of fuel in wing tanks. But at Mach 3 the tanks must be properly insulated and much of the tankage will be within the air-conditioned fuselage, and will interfere with the passenger accommodation. There are likely to be hazards associated with possible fuel or vapour leaks when the aircraft-skin temperature




SONIC BANG.—Mach number and altitude profile to be flown by a Mach 2.2 airliner to avoid sonic-bang nuisance and damage problems at ground level.

is above the spontaneous ignition temperature of conventional hydrocarbon fuels (about 250° C.).

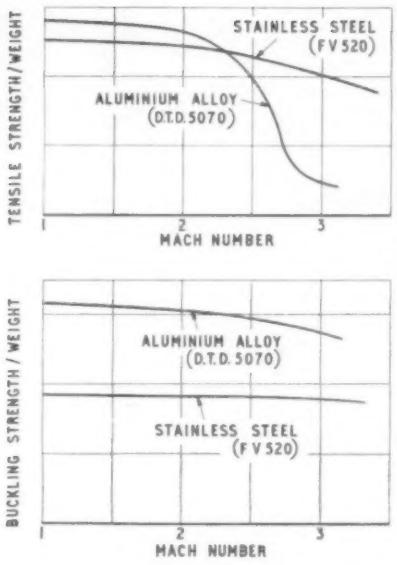
Other problems include the cooling of hydraulic systems and electrical components. Problems associated with aerodynamics and the powerplant cause relatively less concern.

Further uncertainty arises over the extent of flight testing necessary to prove that all aspects of safety would not fall below present airworthiness standards. Hitherto most features adopted for successful civil airliners, including their operating speed, have lagged seven to eight years behind military experience.

For the same payload, the take-off weight of the Mach 3 transatlantic airliner is estimated to be 400,000 lb., against 337,000 lb. for the Mach 2.2 airliner. These weights seem consistent with information obtained from various sources in the United States.

A block-time comparison shows that in both cases some 700 miles are flown in climb and descent at an average speed of less than Mach 1. The Mach 3 aircraft saves about 30 minutes and 20 minutes over the Mach 2.2 aircraft on 3,000 and 2,000 nautical-mile sectors respectively.

An interesting section of Dr. Russell's paper was devoted to noise. He said that in the outer areas around airports noise disturbance was likely to be less with the supersonic types than at present. On the runway itself, sound-pressure levels will only be 2 to 3 db higher than for Conway-engined aircraft. Immediately after take-off the noise will be no worse, and by the time the four-mile point after start of roll has been reached

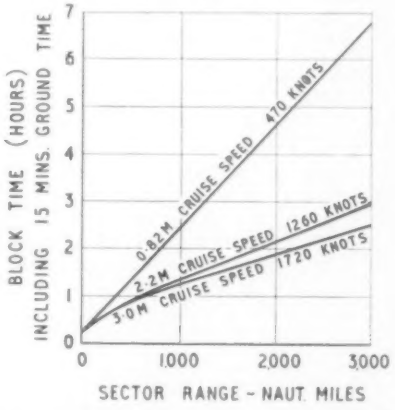



MATERIAL STRENGTHS.—Ratios of tensile and buckling strengths to weight for aluminium alloy and stainless steel after prolonged kinetic heating at Mach numbers up to 3.5.

it should be possible to meet the limit suggested for night operation while climbing on a gradient of just under 5%. This noise level is achieved by climbing at reduced power.

### Operating Costs

A detailed analysis of operating costs for subsonic, Mach 2.2 and Mach 3 airliners is shown above, right. It is based on deriving an airframe cost which will allow economic operation. Most of the calculations are self-explanatory, but some need elucidation. Line 4 gives the maximum potential revenue per lb. weight; it is taken as passenger miles/operating weight empty x 30,000 hr. The units of Line 10, by multiplication of dimensions, reduce to cents (or pence) per lb.




JOURNEY TIME.—Effect of cruising speed on block time for aircraft cruising at Mach 0.82, 2.2 and 3.

Assuming that all aircraft have the same useful life and annual utilization, the relative revenue earning capacity per pound of aircraft empty weight is shown in Line 4 to be 0.64: 0.90: 0.94. Cost of fuel is taken as 14.4 cents per U.K. gallon and the respective fuel costs per passenger mile are 0.37, 0.65 and 0.78 cents (Line 7).

If for the subsonic aircraft the fuel costs represent 27.5% of the *total* direct operating costs, then the "reference d.o.c." becomes 1.35 cents per passenger mile (Line 8). It follows that if all three aircraft are to have equal d.o.c.s, the allowance for all contributing items except fuel can be obtained by subtracting the fuel costs from 1.35 cents, i.e., 0.98, 0.70 and 0.57 cents per passenger mile (Line 9).

Costs in Line 9 can be taken as approximately proportional to initial aircraft price. The major contributions are amortization, insurance, spares and maintenance. Each pound of empty weight can be regarded as having a specific earning capacity (Line 4) and bearing a share of the selling price. Therefore, multiplying the values in Line 4 by those in Line 9, i.e. (passenger miles/lb.) x (cents/passenger mile), gives a measure of the "allowable selling price per pound of empty weight." (Line 10.)

Values in Line 11 show that for equal operating costs, the Mach 2.2 aircraft must not cost more per pound than the subsonic aircraft and the Mach 3 aircraft must cost 10% less. As regards the total complete airframe plus engine selling price, both supersonic aircraft as defined should not cost above 20% more than the subsonic aircraft (Line 12).

| | | M 2.2 | | M 3.0 | |
|---|---|---|---|---|---|
| | | % | lb. | % | lb. |
| a. | Payload crew etc. | 10.0 | 33,700 | 8.4 | 33,700 |
| b. | Weight empty including engines | 45.1 | 152,000 | 43.9 | 175,000 |
| c. | Fuel consumed | 36.8 | 124,000 | 37.5 | 150,000 |
| d. | Fuel carried | 44.9 | 151,000 | 47.7 | 191,000 |
| e. | Take-off weight (a + b + d) | 100 | 337,000 | 100 | 400,000 |

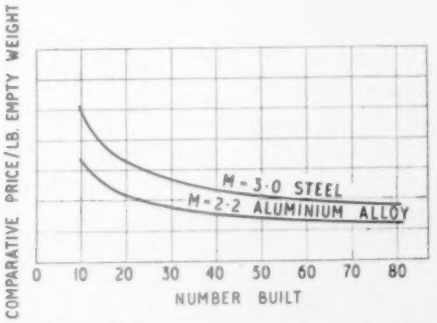
WEIGHTS.—Comparison of weights for Mach 2.2 and Mach 3 airliners which will carry a 28,500 lb. payload, which includes 120 passengers, for 3,000 n. miles.

COMPARATIVE COSTS FIG 8A

AIRCRAFT A REPRESENTATIVE SUBSONIC AIRCRAFT
AIRCRAFT B M 2·2 AIRLINER
AIRCRAFT C M 3·0 AIRLINER

| | A | B | C |
|---|---|---|---|
| (1) OPERATING WEIGHT EMPTY | 128,000 | 152,000 | 175,000 |
| (2) PASSENGERS | 165 | 120 | 120 |
| (3) BLOCK SPEED m.p.h. | 500 | 1130 | 1370 |
| (4) PASSENGER m.p.h./o.w.e. | 0·64 | 0·90 | 0·94 |
| (5) FUEL CONSUMED lb. | 98,000 | 124,000 | 150,000 |
| (6) FUEL / PASSENGER MILE lb. | 0·17 | 0·30 | 0·36 |
| (7) FUEL COSTS / PASS. MILE (c) | 0·37 | 0·65 | 0·78 |
| (8) ASSUMED D.O.C. (37 / 27·5) (c) | 1·35 | 1·35 | 1·35 |
| (9) DIFFERENCE (8) MINUS (7) | 0·98 | 0·70 | 0·57 |
| (10) (9) x (4) | 0·64 | 0·63 | 0·54 |
| (11) (10) / 0·64 | 1·0 | 0·99 | 0·88 |
| (12) RATIO OF UNIT COST (11) x (1) / 128,000 | 1·0 * | 1·17 * | 1·20 * |
| (13) ASSUMED D.O.C. | 1·35 | INCREASED BY 15% | |
| | | 1·56 | 1·56 |
| (14) DIFFERENCE (13) MINUS (7) | 0·98 | 0·91 | 0·78 |
| (15) (14) x (4) | 0·64 | 0·82 | 0·73 |
| (16) (15) / 0·64 | 1·0 | 1·30 | 1·13 |
| (17) RATIO OF UNIT COST (16) x (1) / 128,000 | 1·0 * | 1·54 * | 1·54 * |

AIRFRAME COSTS.—Estimation of relative aircraft costs per lb. of empty weight (Line 11) and per aircraft (Line 12) for supersonic airliners which will have the same direct operating cost as a representative subsonic transport. Lines 16 and 17 give relative costs if the supersonic types have a 15% higher direct operating cost.




PRICE.—Relative prices per lb. of empty weight for Mach 2.2 and Mach 3 airliners.

If it be assumed that the direct operating costs of the supersonic aircraft can be 15% higher than for the subsonic aircraft, the resulting costs per pound of empty weight and the total aircraft prices are shown in Lines 16 to 17. The total aircraft price can now be 50% higher than for the subsonic aircraft.

The economic selling price of an aircraft falls as the number of aircraft produced increases. As a general engineering rule, doubling the quantity makes it possible to reduce the production costs of each unit by about 20%. In the second place the amortization of development costs is spread more thinly.

The effect of the trends is illustrated on the diagram which shows the average cost per lb. weight of Mach 2 and Mach 3 supersonic aircraft, including their engines. The Mach 3 aircraft costs more because of higher developments costs, higher material and tooling costs, higher workshop man-hour content, less experience in fabricating techniques, and greater complexity of certain systems.

The conclusion to be drawn is that if Mach 2.2 aircraft are to be economic for both operator and constructor, then approximately 50 must be sold. To achieve the same economic balance for the Mach 3 aircraft at least 200 need to be sold. These analyses show that the advocates of Mach 3 airliners are confronted with a formidable array of self-imposed difficulties.

# The Fighting Services

## New Cranwell Commandant

AIR COMMODORE E. D. McK. NELSON is to become A.O.C. and Commandant of the R.A.F. College, Cranwell, later this month. At present Air Officer in charge of Administration at Transport Command, he was previously Commandant of the R.A.F. College, Andover.

On taking up his appointment, Air Cdre. Nelson returns to the R.A.F. College for the third time. A cadet at Cranwell in the early 'thirties, he became Assistant Commandant of the College in 1952.

## Boyd Trophy Award

THIS year's award of the Boyd Trophy, presented annually to the most outstanding Fleet Air Arm squadron of the year, has been made to No. 831 Squadron.

Commanded by Lieut. Cdr. B. J. Williams, R.N., the Squadron operates two types; "A" Flight being equipped with Gannets and "B" Flight with Sea Venom FAW.22s. Deployed in the U.K. and aboard carriers, No. 831 Squadron's prime function is to provide aircraft for weapon training exercises and to conduct tactical and equipment trials.

## Fighter Command Aerobatics

IN addition to taking over the main Fighter Command formation aerobatic commitment this year from "Treble One," No. 92 Squadron has exchanged the former's black Hunter F.6s for royal blue mounts. With the Squadron's badge and red-and-yellow chequerboard markings on their nose, the No. 92 Hunters also have a white flash line on the side of the fuselage.

Providing the reserve aerobatic team last year under the command of Sqn. Ldr. R. H. B. Dixon, No. 92 Squadron is now led by Sqn. Ldr. Brian Mercer, A.F.C., a former deputy leader of the Black Arrows. Since Sqn. Leader Mercer assumed command in October, 1960, the Squadron has completed a three-month training programme in Cyprus and will put up a team of nine aircraft.

No. 92 Squadron was first formed on Sept. 1, 1917, and went to France under Major (later Air Marshal Sir Arthur) Coningham equipped with S.E.5A single-seat scouts. During its five months of operation on the Western Front before the Armistice it accounted for 37 enemy aircraft.

Disbanded in 1919, No. 92 came into being again in 1939 and at first flew Blenheim night-fighters. It later received Spitfires and in 1942 went to the Middle East, where it accompanied the Eighth Army's drive across North Africa from El Alamein, moved to Malta, and took part in the landings in Sicily, Italy and Southern France. Later the Squadron operated in support of the advancing Allied armies in Italy, and flew its last operational mission on May 1, 1945. Moving to Austria as part of the occupational forces, it was disbanded on Dec. 30, 1946.

The Squadron was re-formed in January, 1947, and equipped with Meteors at Acklington. These gave way in turn to Sabres, and in 1955 to the Hunter 4s, the Mk. 6s being issued in 1957.

WORKING UP.—The new Fighter Command aerobatic team from No. 92 Squadron based at R.A.F. Middleton St. George, has just completed a three-month training programme in Cyprus. Flying royal blue Hunter F.6s, the Squadron is commanded by Sqn. Ldr. Brian Mercer.

## Famine Relief in Kenya

DURING the first 23 days of last month R.A.F. Beverleys dropped a total of 302,100 lb. of maize, 20,500 lb. of biltong and 2,000 lb. of dried milk to African tribesmen in the famine belt in the Northern Provinces of Kenya.

Undertaken by detachments of Nos. 47, 53 and 30 Squadrons and members of No. 16 Company of the R.A.S.C. Air Dispatch unit, operating from Eastleigh Airport, Nairobi, the food-drops logged a total of 31 sorties in 102 hr. Among those who took part in the operation were the Commander, R.A.F. East Africa, Air Cdre. J. C. MacDonald, and the G.O.C., East Africa Command, Maj.-Gen. R. E. Goodwin.

## R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

**Air Ministry:** Wg. Cdr. R. E. R. Adams and Wg. Cdr. G. F. Banyard to the Department of the Chief of the Air Staff.

**Bomber Command:** Sqn. Ldr. D. J. Corbet to R.A.F. Wittering to command the Administrative Wing; and Sqn. Ldr. G. M. McLean to Headquarters, No. 3 Group, as Chief Signals Officer, both with acting rank of Wg. Cdr.

**Fighter Command:** Wg. Cdr. J. S. W. Bignal, D.F.C., A.F.C., to the Northern Regional Air Traffic Services Centre as Regional Controller and Officer Commanding, with acting rank of Gp. Capt.; Wg. Cdr. K. C. C. Hicks to Headquarters as Command Catering Officer.

**Transport Command:** Gp. Capt. R. J. A. Morris, M.B., Ch.B., D.P.H., to R.A.F. Hospital, Wroughton, to command.

**Flying Training Command:** Wg. Cdr. R. C. O'Grady, M.B., B.Ch., D.P.H., to Headquarters, No. 23 Group, as Senior Medical Officer.

**Air Forces Middle East (Aden):** Sqn. Ldr. C. R. G. Neville, to R.A.F. Khormaksar, Aden, to Command the Flying Wing, with acting rank of Wg. Cdr.

**Other Appointments:** Wg. Cdr. J. Yeadon to H.M.T. "Devonshire" as Officer Commanding Troops: Wg. Cdr. C. B. Wynn Parry, M.B.E., D.M., B.Ch., M.R.C.P., D.Phys.Med., to the R.A.F. Central Medical Establishment as Principal Scientist in Physical Medicine: Sqn. Ldr. A. Harper, A.F.C., to the Ministry of Aviation, with acting rank of Wg. Cdr.

## More Service News

**No. 98 Squadron Reunion.**—A reunion of all former members of No. 98 Squadron is planned for May 27 at the R.A.F. Reserves Club, London. Further details may be obtained from the C.O., No. 98 Squadron, R.A.F. Driffield, East Yorks.

**R.A.F. Benevolent Fund.**—Last year the R.A.F. Benevolent Fund spent £527,979 on relief of distress among former and serving members of the Service and their dependants. Nearly 7% higher than in 1959, assistance expenditure covered 12,585 awards.

**Cyprus Visitors.**—A Royal Hellenic Air Force squadron, flying F-84F Thunderstreaks, visited the Near East Air Force in Cyprus last month at the invitation of the A.O.C.-in-C., Air Marshal Sir William MacDonald. A Turkish Air Force squadron is also to visit R.A.F. Akrotiri following the R.A.F. goodwill flights to Greece and Turkey in 1959.

**Coastal Command Reunion.**—The annual reunion of Coastal Command officers will be held in the Officers' Mess, R.A.F. Northwood, on Saturday, May 27, at 18.00 hrs. Further details and tickets, price £1 each, may be obtained from the Hon. Sec., Wg. Off. S. P. Titcombe, O.B.E., W.R.A.F., at Command Headquarters.

**Tie Profit.**—The R.A.F. Benevolent Fund has received a donation of £50 from the R.A.F. Officer Pilots' Tie Club. Membership of the club is restricted to past and present officer pilots of the R.A.F., R.Aux.A.F. and Dominion Air Forces who have flown at least 500 hours as pilot or have taken part in active service flying operations.

**No. 15 Squadron Standard.**—H.R.H. The Duchess of Kent is to present a Standard to No. 15 Squadron at R.A.F. Cottesmore on May 3. The Squadron extends a cordial invitation to all former members to attend the ceremony and those interested are requested to write to the Squadron Adjutant, R.A.F. Cottesmore, Oakham, Rutland.

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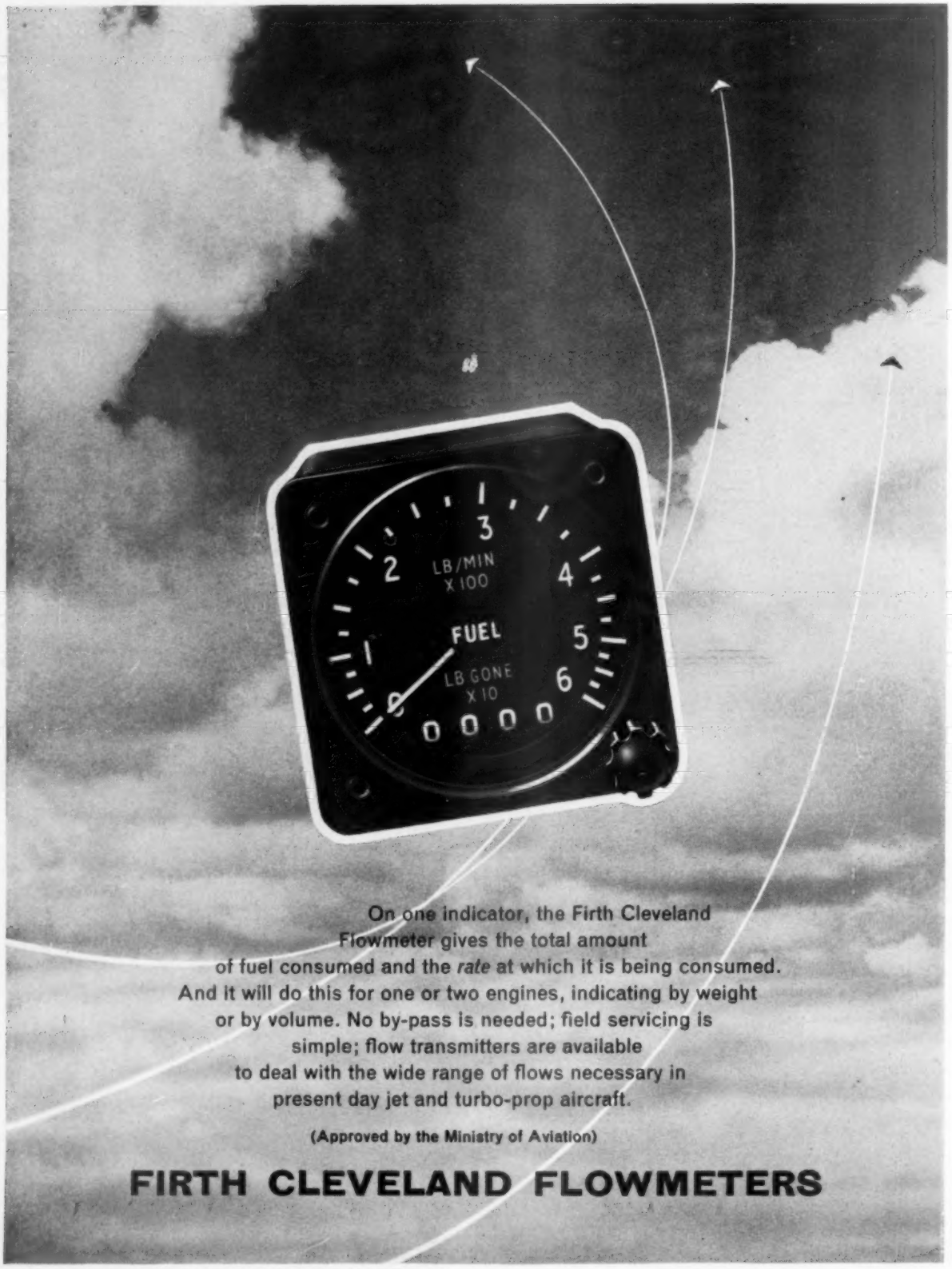


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# Saturn Project Reviewed

*The prototype flight-weight Saturn booster is being prepared for static testing at the George C. Marshall Space Flight Center.*

ALL Huntsville was shaking when the heavy ground-test version of the Saturn booster of 1,500,000 lb.s.t. was put through its successful full-duration test-run on Jan. 31. Noise and vibration depend upon prevailing weather conditions, and the test in question was the second in which Huntsville had felt strong effects.

By the end of the year, Cape Canaveral should hear and feel the blast of the first "flyable" Saturn as it lifts its vast bulk from the launch pad, complete with dummy top stages.

Any day now the first flight-weight prototype of the Saturn C-1 will be leaving the Quality Division of the George C. Marshall Space Flight Center where it has been undergoing extensive checking, to be taken to the nearby Test Division for static firing. Thence it will be transported—by water barge—to the Cape.

**Project History**

As long ago as the spring of 1957, studies were being made by Dr. Wernher von Braun's rocket development group at the Army Ballistic Missile Agency, Huntsville, into the design of large multi-engined rocket boosters. Authorization to proceed with the development of a 1.5m. lb. s.t. booster designed on the clustered engine principle was granted in the late summer of 1958, when the Saturn programme was officially established. Its specific intention was to demonstrate with captive test firings the feasibility of the clustered engine concept.

Some four months later, however, permission had been obtained to build four flight-test vehicles and also to initiate a study of development problems associated with multi-stage Saturn vehicles. And thus preliminary planning for upper stages was also begun.

In 1959, the programme was transferred from the Department of Defense to the National Aeronautics and Space Administration, and on Jly. 1, 1960, the Huntsville development group was officially established under the George C. Marshall Space Flight Center at Huntsville, with Dr. Wernher von Braun as director.

At present, there is a 10-vehicle research and development programme in being which is to be concluded by 1964. At that time, it is proposed that the primary functions of the launchings will be switched from vehicle development to the operational space programme of NASA.

First version of Saturn, the C-1, will consist of three stages named S-I, S-IV and S-V respectively. It will stand about 180 ft. high, 150 ft. without payload. Lift-off weight will be about 1,000,000 lb.

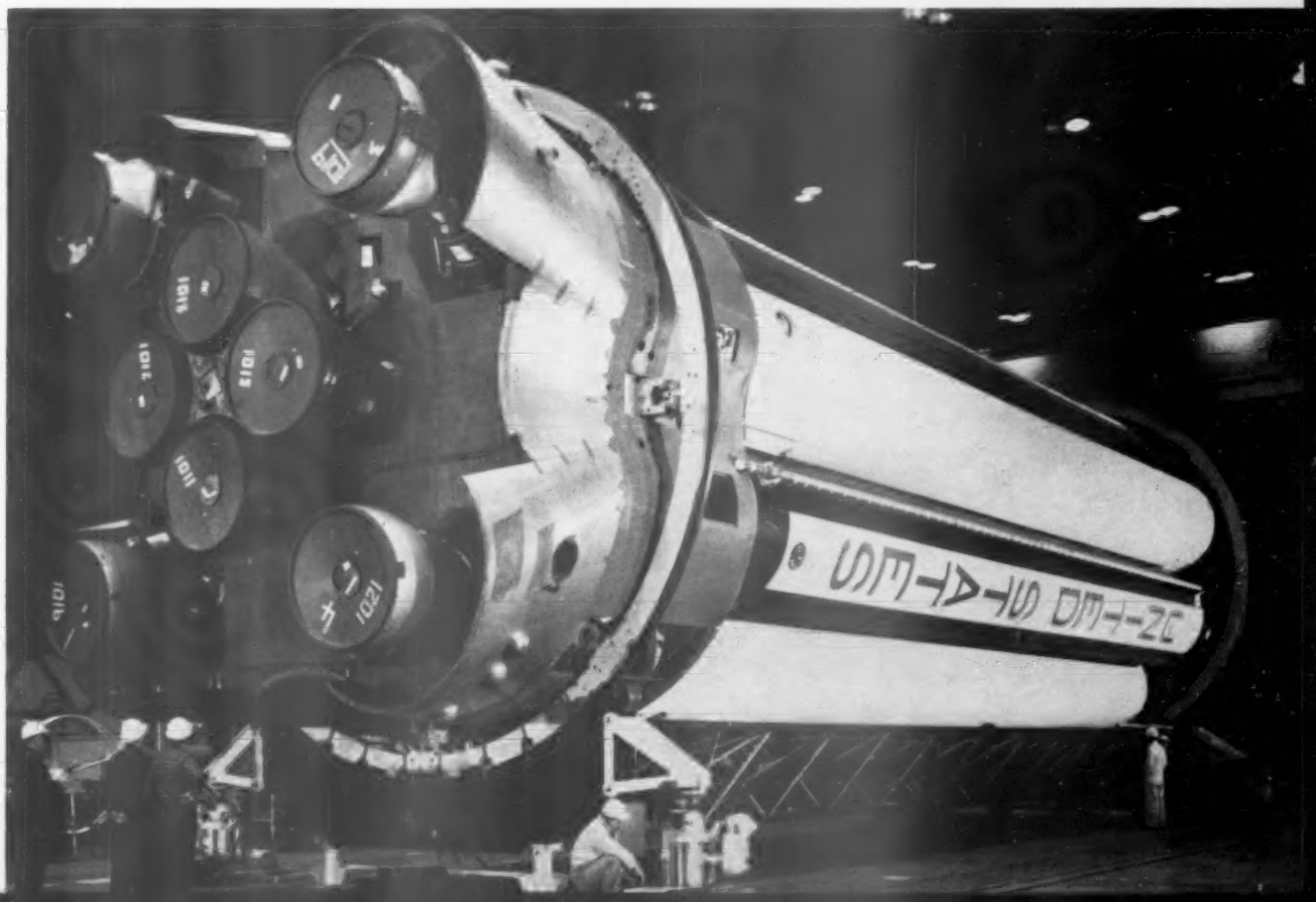
A proposed four-stage configuration designated the C-2 will include an additional stage, named S-II, to be inserted between the S-1 and S-IV stages of the first Saturn configuration. The four-stage C-2 should stand about 230 ft. tall. For some missions, two- or three-stage C-2 vehicles may be used.

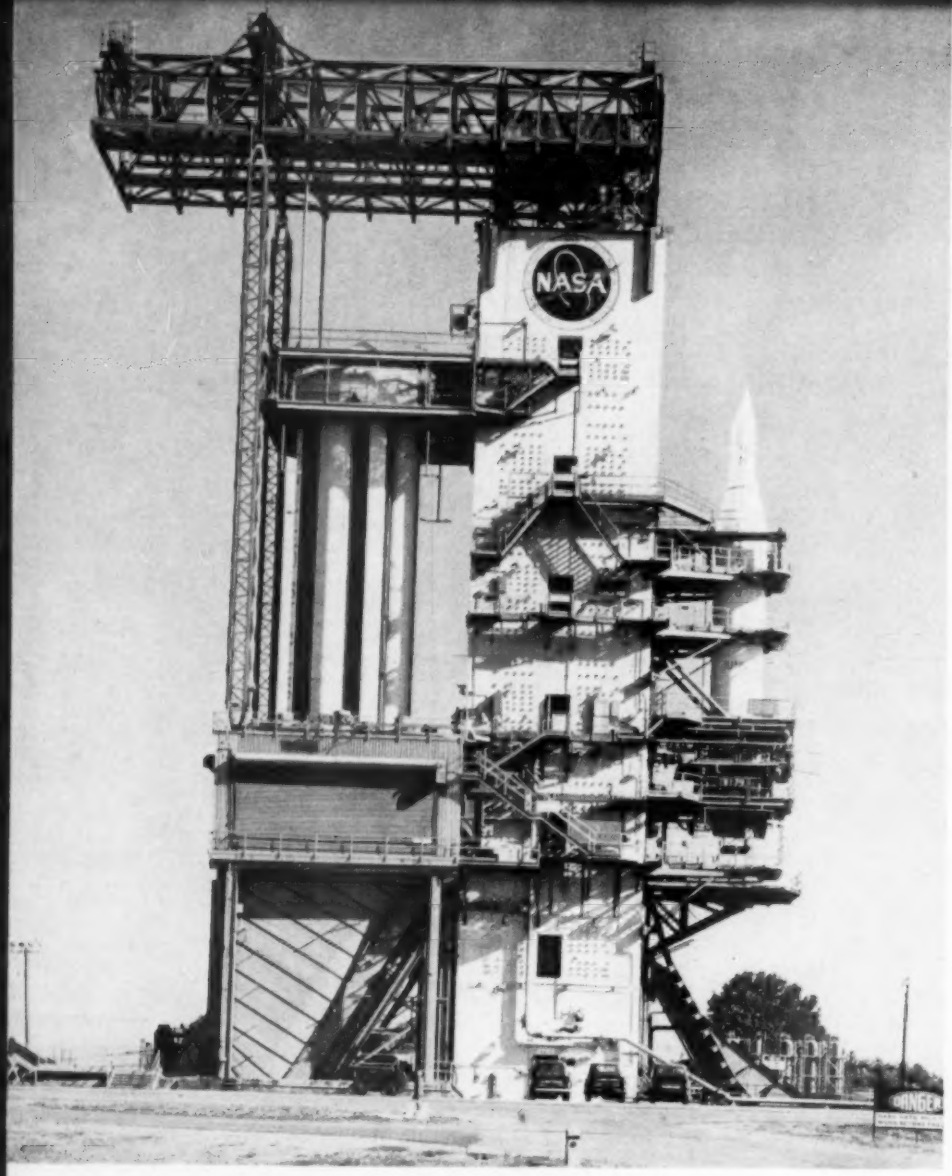
Saturn's S-1 first stage consists of a cluster of eight Rocketdyne H-1 engines, each producing 188,000 lb. of thrust to give a total thrust of 1,500,000 lb., which is the equivalent of 32,000,000 h.p.

The H-1 engine, an advanced and compact offspring of the Jupiter and Thor engines, was selected because of its relative simplicity, early availability, and anticipated reliability. It burns RP-1 (kerosene) fuel and liquid oxygen. Major changes incorporated in the H-1 include location of the turbopump on the thrust chamber below the gimbal block, so that the flexible propellent feed lines to the engine need only carry low pressure propellent, and a simplified start sequence using a solid propellent gas generator.

The eight H-1 engines, attached to an eight-legged thrust frame on the aft end of the vehicle, are arranged in two square

The completed Saturn C-1 booster in the Fabrication and Assembly Engineering Division at the George C. Marshall Space Flight Center. It is 82 ft. long and has a diameter of 258 in.






The heavy-weight Saturn booster is shown here in the static test tower at Huntsville. It has been successfully static-fired a number of times, including full duration runs of more than 120 sec. at 1,300,000 lb. thrust. A Juno II rocket is seen on the right-hand side of the tower.

patterns. The four inboard engines are rigidly attached and canted at an angle of three degrees to the long axis of the booster. The outboard engines are canted at an angle of six degrees and mounted on gimbals which permit them to be turned through angles of about 10 degrees to control the vehicle during first-stage powered flight.

Nine separate tanks feed the eight H-1 engines. Clustered in a circle about a large central tank of 105 in. in diameter are eight smaller tanks, each 70 in. in diameter. The central tank and four outer ones contain liquid oxygen, while the remaining four outer tanks carry the kerosene fuel. The fuel containers are pressurized by gaseous nitrogen carried in 48 glass fibre spheres on top of the tanks, and the liquid-oxygen containers are pressurized by gaseous oxygen obtained by passing liquid oxygen through heat exchangers which are part of each engine package.

The fuel and liquid-oxygen tanks are interconnected in separate systems at the base to allow the maintenance of equal levels in all tanks during burning. If one engine fails and is cut off during flight, this arrangement permits the remaining seven engines to consume the fuel and oxygen intended for the dead engine. In this manner, the burning time of the seven remaining engines is increased and there is essentially no loss in overall booster performance.

The nine propellent tanks are attached at the top by an eight-legged spider beam.

### The Second Stage

The S-IV, which is the second stage of the C-1 vehicle, and would become the third stage in the proposed C-2 vehicle, will be powered by four 17,500 lb. s.t. Pratt & Whitney liquid-hydrogen liquid-oxygen engines. This is the uprated Centaur engine known as the LR119.

The vehicle, 220 in. in diameter and 40 ft. tall, is now under contract for design and manufacture by the Douglas Aircraft Company in Santa Monica, Calif.

Development of the S-IV includes the interstage structure which provides space for the four engines and transmits the load from the S-IV to the upper stage support points on the S-1. This structure will remain with the S-1 upon separation in flight.

The mid-portion of the S-IV is primarily an aluminium cylindrical container composed of an aft liquid-oxygen tank and a larger forward liquid-hydrogen tank separated by a single insulated bulkhead.

Attached to the cylindrical section are small rockets to be used to separate the S-IV from the S-I. At the forward end of the cylindrical container is the structural assembly, or forward adapter which will provide support for the S-V. Retro-rockets for separation of the S-IV and S-V are mounted on this adapter

### Stage Three

The S-V which will be the third stage for the C-1 and the fourth stage for the proposed C-2, will be a Centaur modified for use on Saturn.

The basic pressurized stainless steel structure of Centaur will be used as well as most of the basic components developed by Convair Astronautics at San Diego for the Atlas-Centaur. One exception is the fact that skin thickness must be increased to accommodate the heavier payloads of the Saturn vehicle.

Two 17,500 lb. s.t. Pratt & Whitney engines (the same as used in the S-IV) will propel the S-V which will be of 120 in. dia. and 29 ft. tall.

S-V modification design studies are at present being conducted by Convair Astronautics and a development contract for R. & D. flight hardware will be signed in the near future.

### Saturn C-2

The S-II is to be the second stage in the proposed C-2 configuration for Saturn. Comparable in length and diameter to the S-1, this vehicle will be powered by a cluster of four Rocketdyne J-2 engines of 200,000 lb. s.t. each, according to present plans. A contract for design and development of the J-2 engine was signed recently with Rocketdyne. A contract for the design of the S-II vehicle has not yet been awarded.

### Guidance and Control

Many of the basic features of Saturn's control system are simply adaptations of Jupiter system components to meet Saturn requirements. One significant departure will be the incorporation of rate gyros as sensing elements. Structural bending of the large and relatively flexible Saturn has led to the consideration of rate gyros for stabilization.

Saturn will use all-inertial guidance. Object of the guidance scheme is to provide a universal system which is capable of performing a variety of mission requirements placed on the vehicle to meet payload objectives. This universal guidance concept will allow a variety of requirements with a minimum of changes. Heart of the guidance scheme is a high-speed

| Vehicle Description | Launchings per Calendar Year | | | |
|---|---|---|---|---|
| | 1961 | 1962 | 1963 | 1964 |
| R & D, S-1 with dummy upper stages .. | 1 | 2 | — | — |
| R & D, S-1, S-IV, dummy S-V .. | — | — | 3 | — |
| R & D, S-1, S-IV, S-V .. | — | — | 2 | — |
| R & D, S-1, S-IV, S-V .. | — | — | — | 2 |
| Operational firing .. | — | — | — | 1 |

digital computer. At present computers are being obtained from two different companies for evaluation.

With particular reference to S-I, the guidance system will automatically give corrective signals necessary to compensate for deviations resulting from loss of thrust should one of the eight H-1 engines fail to perform properly.

The proposed C-2 would, in comparison, be capable of placing payloads of 45,000 lb. in close-orbit around the Earth, transporting a manned vehicle around the Moon and back to Earth, or placing instruments on Mars or Venus.

Because of the extensive lead time required to plan and prepare missions for Saturn, mission plans are well under way. Some of the uses under study for the C-1 and C-2 include:—

1. Flights for re-entry tests of the unmanned Apollo spacecraft with near parabolic speed. Gross payload capability of the C-1 for this mission is about 6,000 lb. (Apollo is NASA's planned three-man spacecraft for earth orbital and circumlunar flight.)
2. Orbital qualification tests of the Apollo spacecraft.
3. Mars and Venus probes.
4. Lunar soft landings of large instrumented payloads such as roving vehicles. Planetary satellites for Mars and Venus and circumlunar flights with the Apollo spacecraft.
5. Launching 24-hr. communication satellites, or a carrier for nuclear propulsion tests.

**Transportation**

Because of its size, transportation of the S-1 from Huntsville to Cape Canaveral posed a unique problem. It is too large to be moved by conventional rail, road or air transport. As a result, a 180-ft. barge, the "Palaemon," has been built by Todd Shipyards, Houston, Texas, to transport the booster. The route will include the Tennessee, Ohio and Mississippi rivers, the Gulf of Mexico, and intercoastal waterways to Cape Canaveral on the east coast of Florida. The distance to be covered exceeds 2,000 miles.

Initially, the S-IV stage will be shipped by water from its point of manufacture on the West Coast to Huntsville, via the Panama Canal. At Huntsville, the unit will be inspected with other elements of the rocket before shipment to the launch site.

The S-V, 10 ft. in diameter, can be easily transported conventionally by aircraft.

**Booster Recovery**

Plans are being made to recover the Saturn S-1 to achieve useful economies in the long-term Saturn programme. It may be possible to re-use major components or entire units with relatively minor repair and reconditioning. Two or three possible recovery methods are being examined, including the use of retro-rockets, parachutes and para-gliders.

*Howard Levy photograph*

**Checking a model of the para-glider, one of several proposed recovery systems for Saturn boosters, in a wind-tunnel. Prior to release, the para-glider would be folded longitudinally, between the outer tanks of the booster.**

Saturn's immense size has necessitated the construction of several new development, testing and launching facilities. Among these at the Marshall Center in Huntsville are the modification of a captive test stand to accommodate the S-1, the addition of a dynamic test stand for assembled Saturn vehicles, the planned construction of a second captive test tower, and the modification of several buildings, including fabrication and assembly hangars.

At Cape Canaveral, where the Center's Launch Operations Directorate will launch the rocket, several major construction projects are in progress. A Saturn launch complex, including blockhouse, launch pad and a service structure is to be completed by June. Construction of a second launch complex is also to begin this year.

**Payloads and Missions**

The Saturn C-1 vehicle will theoretically be capable of placing payloads of 19,000 lb. in orbit at 300 miles, of sending 5,000 lb. to escape velocity and placing payloads of about 2,500 lb. on Venus or Mars.

## Animal Farm from Space

ANOTHER Soviet spaceship of 4½ tons mass was launched from the Soviet Union on Mar. 25 and safely recovered. It carried a dog-passenger, Zvesdochka (Little Star), together with mice, guinea pigs, frogs, bacteria, viruses, fungi, some dry plant seeds, onion shoots, various ferments, and "certain other organisms."

This was the fifth firing in the series and the third successful recovery. The previous experiment was on Mar. 9 when a Sputnik carrying the dog, Blackie, and a similar miscellany of smaller animals and plants, was also brought back to Earth after spending a short time in orbit.

If the Russians can achieve another consecutive success, possibly this month, they may be tempted to replace their test animals with a human astronaut, perhaps for the seventh or eighth launching.

## Mercury Control Station

A GROUND station which will take an active part in controlling the Mercury man-in-space experiment was officially opened in Australia by Mr. Hulme, the Minister of Supply, on Mar. 24. It has been established at Muchea, some 30 miles from Perth.

Not only will the station be able to track the capsule but it has been fitted with equipment which will enable ground observers to talk with the astronaut when he is within range. Moreover, under certain circumstances, the station can command the capsule's re-entry into the Earth's atmosphere.

The Muchea station has been built by NASA at a cost of nearly £A200,000. It will be manned by 30 Australian technicians and will have only a few Americans working on specialist duties. In conjunction with another Australian station at Red Lake, near Woomera, which has tracking equipment only, it will be linked to the headquarters command post at Cape Canaveral, Florida, by teleprint and voice circuits. Muchea will be in touch with the capsule for about 10 min. as it passes from west to east at about 18,000 m.p.h.

## Goodyear Solar Collector

INCREASING attention is now being paid in the United States to two new methods of power generation for satellites and space-probes. While silicon solar cells are expected to play a valuable part in space projects for some time to come, the need for higher power levels—such as will be required for the operation of low-thrust electrical propulsion devices—is leading to the development of nuclear power devices and solar reflectors.

In the latter class is an inflatable parabolic reflector which is being developed by the Goodyear Aircraft Corporation. Designed for use with electrical power-generating systems providing three kilowatts and more, the solar reflector, made of aluminized plastic film, is folded and packaged in a two-part cylinder.

The operating sequence would be as follows:—

First, explosive bolts open the container. Compressed gas is then forced into the folded reflector, the open end of which is covered with thin, transparent plastic. This will make the reflecting surfaces uniformly smooth and wrinkle-free.

Next, a lightweight plastic foam will be released to flow between the aluminized surface and an outer wall of film, taking permanent set. Finally, the transparent plastic, covering the open end of the parabolic reflector, will separate from the reflector itself, and the system is ready to operate. At the focus of the paraboloid, solar heat would be concentrated on a mercury "boiler," operating in a closed cycle to drive an electrical turbo-generator. It will, of course, require to be orientated at the Sun.

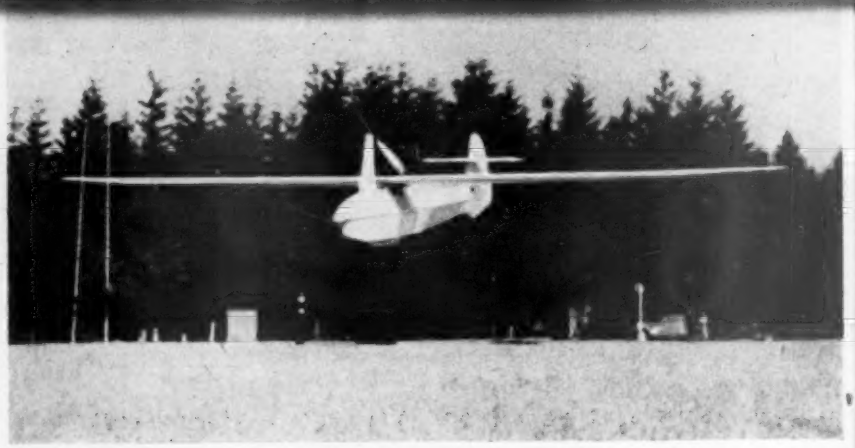
Goodyear believe that solar reflectors as large as 100 ft. in diameter are well within their capability with this technique.

# Manpowered Flight

## *Fact and Fancy*

by

Franz Villinger, Dipl.Ing.



The Mufli with modified tail unit.

IT is almost exactly a quarter of a century since those August days of 1935 when my former colleague, Helmut Haessler and I designed and built the "Haessler-Villinger Manpowered Aircraft." We flew it at Frankfurt-am-Main airport (Rebstock). These flights and those which followed the same year at Frankfurt and at Hamburg-Fuhlsbuettel were, so far as I know, the only flights over level ground ever officially witnessed in which the entire flight, including take-off, was accomplished by the strength or power of the pilot alone. Our machine, which was completed in great haste to meet the competition deadline of Aug. 31, 1935, flew 235 m. (770 ft.) in 24 seconds during the first testing of the propeller drive.

Encouraged by the recent upsurge of interest and renewed attack on this problem of flight by manpower, particularly in England, a number of reports have been published about other attempts on this problem which took place at about the same time as our flights. The claims made for such aircraft, particularly for the Italian Bossi-Bonomi "Pedaliante," which was the only other machine to be taken seriously, and which purports to have flown up to 900 m. (2,950 ft.) in 71 seconds, become no more credible after 24 years than they were at the time.

It seems to me to be worth while for the sake of historical truth to compare the officially observed and partly filmed performance of our Haessler-Villinger manpowered aircraft with the reports of other tests.

It was the lure of the prize of 5,000 marks offered by the Polytechnische Gesellschaft in Frankfurt-am-Main that started us on the building of our manpowered aircraft. This prize was for the first flight in a closed circuit around two pylons, 500 metres (1,640 ft.) apart, on a level airfield using the unassisted power of the pilot, although he was allowed to store energy during the thirty minutes before take-off using equipment carried in the aircraft. This prize for a quite definite performance in what was then the completely new territory of manpowered flight was based on the publication shortly before that time of a note by Alexander Lippisch in *Flugsport* based on Dr. Brustmann's data on the power of athletes over a range of durations.

Unfortunately, these purely theoretical data were used in the design of our "Mufli," the main design basis being a duration of two minutes. It was not realized until our own tests and those of the Muscle Flight Institute, which was founded later, had been done that the earlier data gave more than double the actual power available. For this reason, the prize was not won by our aircraft or by any other, in spite of the prize being increased in 1936 to 10,000 marks.

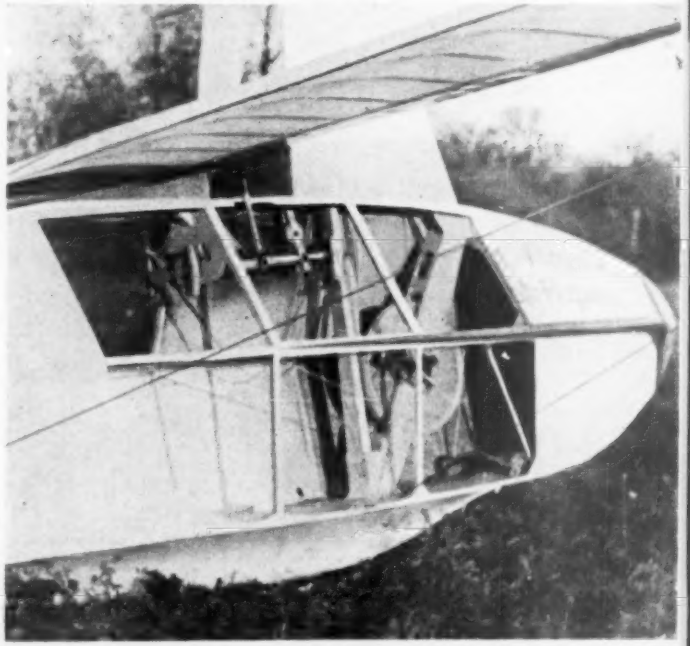
On the basis of experience based on the first contest flights, we made some modifications to our aircraft. The most important of these was the change from wing tilting for longitudinal control with a fixed tailplane to a normal tailplane/elevator arrangement. This greatly improved the controllability.

As a result, in August 1936 at Frankfurt with H. Hofmann, an amateur racing cyclist with a peak power of 1.3 h.p., as pilot, a flight of 397 m. (1,300 ft.) was officially observed. In addition, on the occasion of a conference of the Technical Committee for Gliding of the Lilienthal Society on Nov. 21, 1936, a flight of 427 m. (1,400 ft.) was observed. This flight in a straight line was at Hamburg. On Jly. 4, 1937, we were able, under particularly favourable conditions of weather and location (almost no wind and a very small height difference between take-off and landing) to make a record flight of 712 m. (2,330 ft.) on the Meiningen airport. We considered that this flight was slightly longer than that theoretically possible according to our calculations.

It was considered that any further flying could result in no further improvement in range. Also its low level of structural strength, particularly in wing torsion, necessary to reduce weight to the utmost on account of the competition rules, rendered the aircraft unsuitable for use as a sailplane with auxiliary power at greater altitudes. Consequently, in February 1938 our "Mufli" was accepted by the German Aviation Collection in Berlin where, during the Second World War, like the rest of the collection, it was bombed.

Now we have the designer of the Italian manpowered aircraft, the "Pedaliante" claiming in 1936 to have flown 900 m. (2,950 ft.) in 71 seconds as published in the uncritical article by B. S. Shenstone*. In my opinion this flight could

* "Manpowered Flight Achieved in 1936?", THE AEROPLANE, Aug. 19, 1960.



Above, a close-up of the controls and pedal drive. It seems from this picture that the wing is still pivoted.

Left, The Mufli after modification.

not have been observed by responsible authorities as a true manpowered flight. It would have needed a powerful starting crew (*not* the pilot's own efforts alone) to catapult it up to a considerable height, or sloping terrain, to have made such a flight. The fact that the Italian machine had really a much greater minimum power required than our "Mufli" is quite clear from the following comparison of the essential characteristics of the two aircraft:

| | HAESSLER-VILLINGER | | PEDALIANTE | |
|---|---|---|---|---|
| All-up weight | 242 lb. | 110 kg. | 357 lb. | 162.3 kg. |
| Wing Area S | 105.5 sq. ft. | 9.8 sq. m. | 226 sq. ft. | 21 sq. m. |
| Span b | 44.3 ft. | 13.5 m. | 55.7 ft. | 17 m. |
| Aspect Ratio | 18.7 | 18.7 | 13.8 | 13.8 |
| Drag Area | 0.215 sq. ft. | 0.02 sq. m. | ? | ? |
| Best L/D | 24 | 24 | ? | ? |
| Minimum sinking speed | 1.74 fps | 0.53 m/s | 1.83** | 0.56** |
| Minimum h.p. required (Theoretical) | 0.77 h.p. | 0.78 cv | 1.19 hp | 1.21 cv |

**Calculated. The figure given is 1.05 ft/s (0.32 m/s) which is too low.

Since the "Pedaliante," because of its considerably higher weight and in spite of its 3.5 m. (11.5 ft.) greater span, has a 54% greater theoretical minimum power required than our "Mufli" and since the efficiency of the "Pedaliante's" driving mechanism is less, due to the long shafts and chains and gears to the leading edge, the above figures show quite clearly that the performance information given for the "Pedaliante" would make an unassisted take-off and the claimed performance quite impossible on a level airfield. The clearest indication that the "Pedaliante" was not as good as our "Mufli" so far as achieved performance is concerned is that the maker of this aircraft made no reply whatsoever to suggestions made for competitive or comparative flights.

These proposals were made by ourselves, by the Italian Consul in Leipzig and above all by Mr. Seiboth, the publisher of the magazine "Der Sportflieger."† The value of 0.32 m./sec. (10.5 ft./sec.) given for the sinking speed of the "Pedaliante" can only be accepted if it refers to the sinking speed experienced during the whole muscle-powered flight of 900 m. (2,950 ft.) which would be quite consistent with the quoted duration of 71 seconds.

Twenty-five years have gone by since the above described practical experiments were made on the problem of man-powered flight. It is therefore natural for one to be keen to see what the improvements in performance resulting from the advances made during this period in aerodynamics and newly developed structural materials will achieve by the new experiments in England. Whether the much more difficult conditions required by the Kremer Competition compared with those of the Polytechnische Gesellschaft from 1934 to 1936 can be fulfilled within the foreseeable future seems to be highly unlikely on the basis of our experience. In the interest of true encouragement for the maximum possible number of designers, it would in my opinion be preferable to offer one or more prizes for the longest pure manpowered flight in a straight line, with a requirement that it be at least 500 m. (1,640 ft.).

(Translated by B. S. Shenstone.)

[It is understood that the Italian Authorities made life rather difficult for Bossi and would not allow him to take the "Pedaliante" out of Italy. Perhaps they would not let him contact Villinger.]—B.S.S.

† "Das Luftskiff"—*Flugsport* 1933 p. 311.

# From Muscle to Propeller

INTRODUCING his lecture on "Power Transmission Systems" to the Man-powered Aircraft Group at the Royal Aeronautical Society on Mar. 17, Mr. S. S. Wilson, Demonstrator in Engineering Science at Oxford, hoped this was not to become another of those lost causes for which his University was the reputed home. However, it should not happen if all concerned with the problem were blessed with the resources, as well as the skill to use them, enjoyed by Mr. Wilson, for he has been able to set up a rig for testing the efficiency of over a dozen different kinds of drives which could be used for transmitting human muscle power to a propeller. The results he gave were provisional estimates; he expects to publish more precise figures later.

Beginning with the bicycle chain, which has an efficiency of 98.5% but cannot be twisted through 90 degrees, Mr. Wilson went on to consider various kinds of belts. A flat belt with a nylon core and leather facing suffers from 2½% creep and its efficiency is only 97%; so is that of a Vee-section belt, which imposes less tension loads on the structure and can be twisted.

Minimum tension on the structure is given by the toothed belt, an advantage which it shares with the bicycle chain; but at 0.265 lb. per ft. it is considerably heavier than other forms of belt, though lighter than the chain; its efficiency of 99.5% is the highest of all the systems tested. A perforated steel belt still awaits testing.

Next came gears, which Mr. Wilson assumed would be used with a thin tubular shaft such as dural, 1.25×0.022 in., weighing 0.103 lb. per ft. He did not think highly of them, especially bevel and worm gears, which are not only inefficient, and are specially sensitive to distortions of the aircraft structure, but cannot damp out the cyclic variations of thrust which are inevitable when human muscles work a pedal drive.

This last disadvantage applies also to Hookes joints, which transmit thrusts across the junction of two shafts, though their efficiency should be high even when the directions of the shafts differ by 10° and possibly up to 20°. They still await testing. Best of the gear systems is a roller cam, with 99% efficiency.

A less orthodox system, the flexible rotating shaft bent into an arc, aroused Mr. Wilson's special interest. It might be suitable either for working a propeller at the tail, or for a pusher propeller on a pylon above the wing, worked by a pilot lying on his back with his feet raised. It would have to be run below its primary whirling speed, and its natural frequency of torsional oscillation would have to be well below the frequency of cyclical torque caused by pedalling.

How about applying power to a wheel during take-off? Mr. Wilson suspected it would not be worth while, but Mr. B. S. Shenstone, the chairman, mentioned that the pre-war Italian experimenter Bossi found it impossible to take off without driving a wheel. On this subject Mr. Wilson gave a most useful tip: you can reduce the rolling resistance on take-off considerably by pre-heating the tyre to 70° C.—A.E.S.

**SUMMARY OF TRANSMISSION SYSTEMS**

| System | Estimated efficiency % | Weight, lb./ft. | Load on structure | Sensitivity to deflexions | Able to reduce cyclic variations? |
|---|---|---|---|---|---|
| Chain | 98.5 | 0.41 | Min. tension | Shortening | Yes |
| Belts: | | | | | |
| Flat nylon/leather | 97 | 0.15 | Large tension | Small | Yes |
| Toothed | 99.5 | 0.265 | Min. tension | Shortening | Yes |
| Vee | 97 | 0.094 | Medium tension | Small | ? |
| Steel–plain | 99 | 0.039 | Large tension | Shortening | Yes |
| Steel-perforated | ? | 0.038 | Small tension | Shortening | Yes |
| Gears: | | | | | |
| Spur | 97 | — | Direct thrust | Twisting | ? |
| Bevel | 94 | * | Direct and side thrust | Any deflexion bad | No |
| Worm | 89 | * | End thrust | Twisting | No |
| Roller cam | 99 | * | End and side thrust | Small | Yes |
| Hookes joints | ? | * | Small | None | No |
| Double crank | 96.5 /96.5 | † | Large thrust and tension | Small | No |
| Flexible shaft | 99 | .127–.30 | Small bending moment | None | Yes |

* All these would be used with a thin tubular shaft, e.g. Dural]1¼ in.×0.022 in. at 0.103 lb./ft. †2 tubes ¾ in.×.028 in.=.154.

## Airships as Wind-tunnels

PROFESSOR HAZEN, professor of aeronautical engineering at Princeton University, is using one of the U.S. Naval ZS2G-I airships with considerable success to test wind-tunnel models. The aircraft model is attached to a strut, and hangs below the airship.

The airship is used to test slow-speed aircraft, and especially for craft designed to operate with very short runways, or even vertically. Professor Hazen, thinking that airships were on their way out, went for a flight in one, and was impressed with the smoothness, and the fact that there was no vibration at speeds between 0 and up to over 60 kts. Reports from the U.S. suggest that quite a number of aeronautical engineers are now taking an interest in airships for similar purposes.—V.

# Personal Flying

PROGRESS with the Morane-Saulnier Rallye series continues; 270 orders had been confirmed by Mar. 20, and the second prototype, to production standards, is currently undergoing C. of A. tests at Bretigny. Since its first flight on Feb. 10, the Rallye-Club O2 had logged about 40 hr. before going to Bretigny, while the first prototype, at the end of its recent tours to Copenhagen and Stuttgart, had completed about 900 hr.

The third prototype, which will be the first M.S. 885 Super-Rallye, with a 145 b.h.p. Continental engine, is due to make its first flight early this month, and it is then scheduled for a demonstration tour in the United States. The U.S. agent for the Rallye, Mr. Coleman, has ordered three aircraft in an initial contract, while in Canada, a company with the name of "Rallye Aircraft of Canada" has been formed by Mr. Paulson. Other agencies have been established in New Zealand, where six confirmed orders have been placed by Mr. Seabrook, and in Peru.

Confirmed orders now exceed the initial production quantity of 250 Rallyes laid down by Morane-Saulnier. Of the 270 orders, 107 are for French customers and 163 for export. Three per cent. are for the 90 b.h.p. Rallye-Club, 45% for the 100 b.h.p. version, and 52% for the Super-Rallye. More demonstrations are to be made in France with the Rallye by M. Jacques Noetinger.

• • •

The Royal Danish Aeroclub has undertaken an interesting survey into the holders of a Danish P.P.L. At the beginning of this year there were 359 holders of a current private pilot's licence in Denmark, the largest number since the peak years shortly after the War. Eighty new licences were issued during 1960, the highest number since 1948, when 174 were issued.

While the "life" of a P.P.L. in the first half of the 50's averaged only four years, it was seven years in the second half. But only 10 pre-War private pilots are still flying actively, and a mere 10% from 1948 are currently active.

Only six have more than 1,000 hours flying, 54% having less than 100 hours. Ten hours a year is the minimum to hold a licence, unless the candidate is also a soaring pilot. The survey shows that 66% of the pilots fly less than 15 hours a year, most of them 10-11 hours. This would seem far below the level to maintain proficiency.

Although much is talked about business flying in Denmark at the present time and many new aircraft have been imported, most pilots still seem to be amateurs flying for pleasure and not able to afford more than the minimum demanded. Only 15% of them are owners of aircraft.

• • •

A recent addition to executive operators in the U.K. is the firm of Dispatch Motors of Southwark Bridge Rd., London's main Ford dealers. The company has acquired a Piper Tri-Pacer, G-APXT, which is flown by the Managing Director, Mr. D. M. Rowse, and is used to facilitate coach sales throughout the country.

Its inaugural flight took place recently when Mr. Rowse, accompanied by Sales Manager A. J. Barton flew to Long Itchington in Warwickshire from its base at Fair Oaks to hand over log books and documents to Mr. Frank Smith of Frank Smith Coaches, near Rugby. Mr. Smith had recently taken delivery of two new 41-seater Thames Duple coaches.

• • •

As we predicted in our issue of Feb. 3, public acceptance of the $4,995 two-seat Colt has far exceeded the expectations of the Piper Aircraft Corporation. The Colt was conceived as a low-cost side-by-side trainer for airport operators, and a production run of 425 was planned by next September.

Current backlog of orders is close to 500 Colts, and production for the period will now approximate 1,100 of these aircraft, or nearly three times the original plan, according to Piper General Sales Manager J. W. Miller. "The reaction has been even better than we anticipated among operators," said Mr. Miller, "but the acceptance by private pilots has far exceeded anything we contemplated."

• • •

● The Chipmunk of the St. Edward's Flying Group, whose members are mainly drawn from St. Edward's School, Oxford, has flown throughout the British Isles in its first year of operation from the Scillys to the Orkneys, and has also toured the Continent. Plans are in hand for an ambitious flight to North Africa during the summer.

# *Gliding Notes*

*by Dr. A. E. Slater*

A PARTY of members of B.E.A. Gliding Club have been over to France to try out the Choucas, alias Breguet 906, which is largely a two-seater version of the Fauvette, or 905, and similarly has a V-tail. They were surprised at having to be "passed out" on the Fauvette before going up in the Choucas with the test pilot, M. Merloz, instead of the other way round.

At its speed for best gliding angle, 50 m.p.h., a 45-degree banked turn can be reversed in 4.5 seconds. It stalls at about 37 m.p.h. Altogether the B.E.A. party were pleased with it. So, evidently, are the French authorities, for their Government has given Breguet a contract for 100 machines for the state gliding schools and clubs.

* * *

EAST German sailplane designs are described in pamphlets brought back from the Leipzig Fair by Cdr. E. P. Young. The Libelle, which has already been going strong for a few years, is now being produced in a laminar-flow version.

The original Libelle had a span of 16.4 m. (54 ft. 2 in.), but a 15-metre alternative was produced when the Standard Class was established. The best gliding angle for these two types is 1 in 31.5 and 28.5 respectively, and minimum sink 0.66 and 0.73 m/sec.

The laminar version is claimed to have a gliding angle of 1 in 36 at a speed of 88 k.p.h. (55 m.p.h.), as against 78 k.p.h. for the non-laminar; minimum sink, 0.65 m/sec., is hardly altered, but is obtained at 76 k.p.h. (47.2 m.p.h.), and landing speed is 12 k.p.h. faster at 62 k.p.h. The laminar wing is "accomplished in standard wood construction with a backed dural foil, and glued with plywood covering."

A two-seater training machine, the Lehrmeister, wears 15-m. span wings for training beginners and 17-m. span for high-performance pupils, "including danger instructions and simple trick flying." Best gliding angles are 1 in 23 and 26 respectively, and minimum sink 0.95 and 0.80 m/sec., while landing speeds are 72 and 74 k.p.h. (44.7 and 46 m.p.h.) respectively. Neither for this nor for the Libelle is the high-speed performance given. Another machine, the Lo-Meise, is evidently an East German version of the Olympia's forerunner. Best gliding angle is 1 in 23.

* * *

*AERO-SPORT*, the East German aviation magazine, compares the triangular speed records of East and West Germany. East comes off best with the single-seater 300 km. triangle at 68.4 k.p.h., compared with the West's 66.5 k.p.h.: but with the other five records the West has an advantage ranging from 1.35 k.p.h. for 100-km. single-seater to 21.53 k.p.h. for 300-km. two-seater.

East Germany's decentralized contest this year runs from Mar. 15 to Sept. 30. Last year's winner was Adolf Daumann of Schwerin.

At the other side of the Communist world is a Chinese-designed training two-seater. A visiting Polish party has been stimulating Chinese gliding, and one of them, Josef Nieslpala, advised the designers of the new machine, Chen-Kuei-Weng and Li Ti-Tiun.

Called Lie-Fang, which means "liberation," the machine is a tandem two-seater with a span of 15 metres, aspect ratio 12.4, all-up weight 882 lb., and wing loading 4.4 lb./sq. ft. It is a mid-wing type, with the leading and trailing edges sprouting from exactly half-way up the fuselage; the wing is fabric-covered behind the torsion-box. In fact, it looks pretty conventional, and the gliding angle, given as 1 in 21, shows that there is little laminar flow.

Pupils graduate from the Lie-Fang on to a Polish Mucha for first solos.

* * *

A REGIONAL GLIDING CONCOURSE is announced in France by the Union of Aero Clubs of Bordeaux and the South West; it will be held at the Niort-Souché aerodrome on May 20, 21 and 22.

Regional contests in England during the Easter holiday were at Long Mynd in Shropshire and Swanton Morley in Norfolk, while at Bicester the R.A.F. teams for the National Championships were to be practising. The Championships are at Lasham, Hampshire, from May 13 to 22, and the second International Glider Trade Fair is also there on May 13 and 14. Anyone wanting to exhibit should contact Sqn. Ldr. J. C. Ward, Nettlebed House, Nettlebed, Oxfordshire.

# Correspondence

## Executive Developments

IN a recent column of "Wroundabout," we read with interest Wren's comment on United's Executive "Men Only" flights.

I think I must say that the "Men Only" concept was not in any way designed to utilize piston aircraft, as the Executive flights are somewhat of an institution with us now, having been in effect for somewhere in the neighbourhood of eight years.

As a matter of fact, it is probable that soon we will replace the Executive equipment with a jet. It has not only been an extremely popular flight over the years, but other airlines have sought to duplicate the service in one form or another.

London, W.1. EDMUND STOHR.
(European Director—United Air Lines.)

## Getting the X-15 Facts Right

REFERRING to your account of the latest speed achievement of the North American X-15 on Mar. 7, reported in THE AEROPLANE AND ASTRONAUTICS, Mar. 17, p. 277, may I point out that the mish-mash of figures on this effort has become somewhat garbled in the brave attempt to squeeze two eggs into one egg-cup.

Your own report, exemplified in the second paragraph, gives the speed of 2,905 m.p.h. correctly, but misstates that the X-15 climbed from 45,000 to 75,000 ft. at the peak of its climb profile. My own despatch stated correctly that the X-15 reached a ceiling of 77,000 ft. and, just after the round-out, attained its maximum speed of 2,905 m.p.h. (Mach 4.43) at 76,160 ft. These are the corrected instrumentation figures, checked and confirmed by both the N.A.S.A. and North American Aviation.

The next mission of the high-powered (XLR-99 rocket-engine) X-15 will be an altitude step from its current maximum of 136,500 ft. to about 150,000 ft. and will be flown by N.A.S.A.'s chief engineering test pilot Joseph A. Walker. Walker has made five previous X-15 flights with the smaller interim rocket engines (XLR-11), but this will be the first full-scale attempt to rely on the reaction control system of small rocket thrust chambers in the fuselage-nose and wing-tips; these are controlled in the cockpit by a side-arm controller on the pilot's right-hand side, the controller being integrated with the conventional centre stick.

I regret that you were not able to publish my modest tribute to Scott Crossfield and his fellow test pilots, White and Walker, who have brought the X-15 up to its present adventurous poise on the fringe of space flight. Just before closing down this note on Mar. 21, the news came through over the air that Walker had to abort his scheduled launch that day to the planned 150,000 ft. At 12,000 ft. a malfunction occurred and the B-52 carrier had to land with its X-15 and pilot still shackled under its wing. Over the air came the cool voice of Joe Walker: "O.K. You guys trying to cut down my flying time!"

Santa Monica, Calif., U.S.A. STANLEY H. EVANS.

## That Airport Parking Problem

HOW often does one hear in these days of agitated travel that "time is money"? While there may be an element of truth in this modern saw, it is used all too frequently as an excuse for the extraction of exorbitant sums of money from ordinary folk who have a simple objection to just wasting time. A classic example has recently come to light in the announcement of a new scale of car park fees at London Airport.

For a two- to four-day parking, the cost is now £1 *per day*; for periods longer than four days, it is £2 *per day*. In all conscience this is putting a pretty high premium on the Ministry of Aviation's sense of financial proportion in relation to its customers. Indeed, levying such a high toll is yet another illustration of the assumption, made in most State enterprises, that all members of the travelling public are equipped with bottomless purses of the expense-account type.

No one will deny that the central area at Heathrow is liable to congestion—this is an inevitable penalty of the island layout—and clearly steps must be taken to reduce the congestion to a minimum if the Airport is to function. Likewise it is hardly fair to complain about the cost involved in stays of a week or more. After all it is no part of an airport's function to act as a car storage depot.

But for the short-term traveller living on the outskirts of the Metropolis, a real problem does exist in terms of the amount of time that has to be *wasted* in getting to the airport if a car is not used.

For example, there are many thousands of ordinary air travellers who live within a one-hour car journey from the centre of the airport. For them to travel by public transport to the city air terminal and thence by airport coach can mean a transit time of as much as 2½ hr. For all these travellers, there can be 3-4 hr. of sheer wasted time on a return air journey.

To have to pay £2 or so for the privilege of avoiding this quite unnecessary waste on a two/three-day trip will not make a great deal of sense to the average tourist traveller on Continental or domestic routes. Heathrow is far too inaccessible as it is; penalizing those who can mitigate the nuisance for themselves is no way to solve the problem—or make air travel more popular.

A correspondent in your Mar. 10 issue draws attention to another aspect of this airport parking problem. "Parking space for private cars is not always immediately available in the central area," he says. This is another potential time-waster—but at least it is one which may disappear by the removal of all those vehicles in the car park which are either stored there for more than four days or which are not *bona fide* travellers' cars.

Of course, the only way to solve the problem is to provide adequate parking space in the first place. On all the hundreds of acres comprising Heathrow there must be enough "dead" ground for such a purpose. A 50-yd. strip taken off the perimeter all the way round its five miles, for example, would surely accommodate all the cars that are likely to require accommodation at any given time. Their occupants could easily be transported to the central area without undue delay by means of a constant circulation of small buses.

Edgware, Middx. "TOURIST."

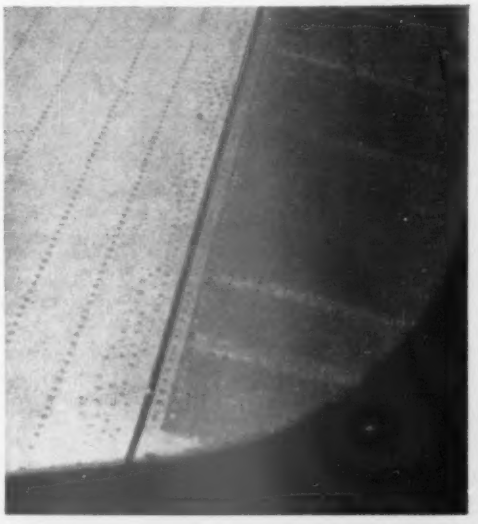
## Wroundabout

### Shocks in the Sky

The accompanying photograph is optimistically titled "Portrait of a Shock Wave," the manifestation of compression being the thin white line running diagonally from top left to bottom right. The picture was taken through a cabin window of a Lima-bound B.O.A.C. 707 flying at 35,000 ft. at Mach .82, and shows part of the starboard wing and inboard flap. A similar wave hovered over the port wing. Both extended for about the inner third of each wing's span.

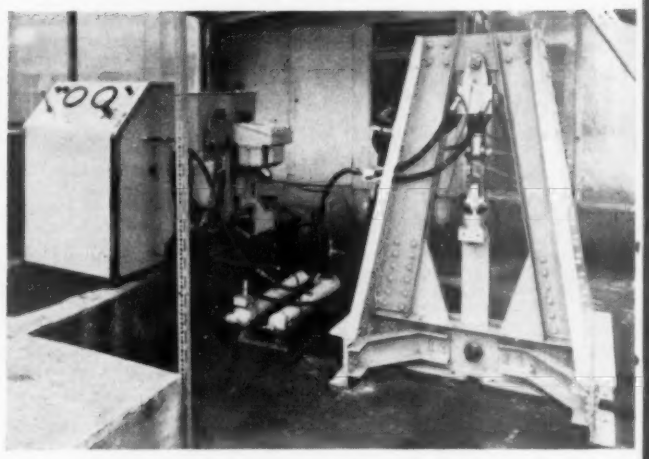
There was something uncanny about that shimmering line out there—as another expert said: "You'd think it would blow away." It moved like a dragonfly, poised and quivering for a few seconds, then darting forward or backward an inch or so. I wondered what the wave was like in section and why it should be visible.

The late John Derry was, I believe, one of the first to report a shock wave in action outside a wind tunnel. These columns carried a letter from him some 10 or more years ago.



by Wren

# Industry Record



This hydraulically operated vibrator has been produced by Dowty Rotol, Ltd., for vibration and high frequency fatigue testing. It will operate at frequencies of up to 500 c/s.

### High-speed Windscreens

Windscreen panels of alumino-silicate glass for use in high-speed aircraft are being developed by the Triplex Safety Glass Co., Ltd., in conjunction with Pilkington Bros., of St. Helens. This type of glass contains a higher percentage of aluminium oxide than that normally for aircraft use. It is claimed that no loss of strength occurs at temperatures ranging from −80° C. to +200° C. This makes it suitable for use at speeds up to about Mach 2.

In the past alumino-silicate glass has been used for discharge lamps for street lighting and similar articles but has never been made to optical standards or in sizes as large as those required for aircraft panels. The first, it is hoped, will be ready for use by the end of the year. In certain cases they will be gold-filmed for de-misting and de-icing by electrical transmission.

### Hawker Siddeley Electronics

Two members of the Hawker Siddeley Group, Armstrong Whitworth Aircraft, Ltd., and the Brush Electrical Engineering Co., Ltd., have joined their electronics sections to form a partnership known as Armstrong Whitworth-Brush. This will manufacture and market advanced electronic and electrical control and intelligence systems. First orders received by the new partnership are for data link equipment for a radar installation and recording equipment for experiments in the detection of underground nuclear explosions.

### Finishes on Show

An International Industrial Finishes exhibition, the first of its kind in this country, is to be held at Earls Court, London, S.W.5, from May 8-11. All of the main surface-finishing techniques and processes will be represented as well as allied plant and materials. A convention at which 16 papers will be read will run in parallel with the exhibition.

### Met. Information by TV

Increasing use of closed-circuit television is being made in air traffic control. Yet another use will come into operation soon when equipment produced by Peto Scott Electrical Instruments, Ltd., in collaboration with the M.o.A. is installed at Bahrein Airport. This has been designed to provide instant transmission of meteorological information to a number of remote monitors in various parts of the control tower.

Metal conditions at any given time are recorded on a standard form. This is placed face downwards on a glass window on the top of a console containing the TV camera. Upon closing a lid a 35 mm. camera automatically takes a photograph of the form as displayed on the face of the monitor; simultaneously, red lights flash on all monitors to which the information is being relayed.

After taking note of the message, the recipient cancels the flashing light by pushing a button. This also cancels an indicator light on the transmitting console giving an indication that all positions have received the information. Should the recording camera fail because of mechanical defect or lack of film a warning lamp lights.

### Index Available

The index to THE AEROPLANE AND ASTRONAUTICS, Volume 99 (July-December, 1960), is now in print. Copies are available on receipt of 4d. to cover packing and postage. Applications should be addressed to Temple Press Limited, Bowling Green Lane, London, E.C.1.

### Holding Company

The issued share capital of the three British CIBA companies, CIBA Laboratories, Ltd., makers of pharmaceutical products, CIBA Clayton, Ltd., a company selling dyestuffs, and CIBA (A.R.L.), Ltd., manufacturers of synthetic resins and adhesives, has been acquired by a new company, CIBA United Kingdom, Ltd. This has been formed with an authorized capital of £3 million by CIBA, Ltd., Basle, to act as a holding company for its subsidiary's interests in this country. Also included is the controlling interest held by the Swiss concern in the Clayton Aniline Co., Ltd.

Dr. R. Kappeli, of the Swiss company, has been appointed chairman of CIBA United Kingdom, Ltd., and Sir Arthur Vere Harvey is managing director. Sir Joseph Napier is a director. The registered office is at 96 Piccadilly, London, W.1.

### TACAN Testers for the R.C.A.F.

A contract for the manufacture and supply of 60 test sets to be used for preflight checking and simple workshop servicing of the ARN-52 airborne TACAN system has been awarded to G. and E. Bradley, Ltd., an associate company of Joseph Lucas, Ltd. This TACAN system is now being brought into use with the R.C.A.F. Worth £46,000, the contract is for the Bradley test set UE.45 and was secured against strong competition from U.S. manufacturers. When in use with the R.C.A.F. it will be known as test set radio AN/ARM-501.

Originally developed to meet an M.o.A. requirement, the test set provides a rapid and accurate accept/reject test and is used by both the R.A.F. and the Royal Navy.

## Aviation Calendar

**Apr. 8**

**Birmingham.**—B.I.S., Midland Branch lecture, "Some Astronomical and Astronautical Aspects of the Moon," by K. Fea, in the Birmingham and Midland Institute Cinema, Paradise Street, at 18.30 hrs.

**London.**—B.I.S. lecture, "Orbital Rendezvous Techniques," by E. M. Dowlen, in the R.Ae.S. Lecture Theatre, 4 Hamilton Place, W.1, at 18.00 hrs.

**Apr. 10**

**Amesbury.**—R.Ae.S. Boscombe Down Branch Film Show, in the Lecture Hall, A. and A.E.E., at 17.30 hrs.

**Brussels.**—AGARD Flight Mechanics and Fluid Dynamics Panels joint meeting on Stability and Control; until Apr. 15.

**Lisbon.**—AGARD AeroSpace Medical Panel Spring Meeting.

**London.**—R.Ae.S. Historical Group Discussion Evening, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

**Apr. 11**

**London.**—R.Ae.S. lecture, "Direct Electrical Power Generation by Thermal and Chemical Means," by Prof. M. W. Thring, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.00 hrs.

**London.**—GAPAN Annual Banquet at the Guildhall, at 19.00 hrs. for 19.45 hrs.

**Luton Airport.**—R.Ae.S. Luton Branch lecture, "Reliability," by Air Marshal Sir Herbert Spreckley, in the Napier Senior Staff Canteen, at 18.00 hrs.

**Apr. 12**

**London.**—R.Ae.S. Graduates and Students Section lecture, "Man Powered Flight Progress to Date," by B. S. Shenstone, in the Lecture Theatre, 4 Hamilton Place, W.1, at 19.30 hrs.

**London.**—Kronfeld Club lecture, "Pilcher, the Pioneer of British Aviation," by Lord Braye, in the Basement, 74 Eccleston Square, S.W.1.

**Apr. 15**

**London.**—Science Museum lecture, "The Story of Flight," by Victor Wall, at the Science Museum, S.W.7, at 15.15 hrs.

## Company Notices

**NEW COMPANY**

**COLDRAM, LTD.** (686,812).—Private co. Reg. Mar. 17. Cap. £100 in £1 shs. To carry on the business of automobile, marine and aircraft engineers. Sec.: Lawrence R. Battell. Reg. off.: 13 Well Court, Bow Lane, E.C.4.

## New Patents

**APPLICATIONS ACCEPTED**

867,807.—**Gloster Aircraft Co., Ltd.**—"Fluid-flow detectors."—Oct. 30, 1958. (Nov. 1, 1957.)

867,419.—**Autoplug Gerhard Sedlmayr G.m.b.H.**—"Parachute coupling devices."—Sept. 16, 1957 (Sept. 17, 1956.)

867,522.—**Martin-Baker Aircraft Co., Ltd., and J. Martin.**—"Firing mechanisms suitable for aircraft seat ejection devices."—Jly. 21, 1958. (Aug. 2, 1957.) (Addition to 815,058.)

867,944.—**Power Jets (Research and Development), Ltd.**—"Airfield ground equipment for vertical take-off aircraft."—Nov. 5, 1959. (Nov. 21, 1958.)

Printed specifications of the above will be available on May 10, 1961, and the opposition period will expire on Aug. 10, 1961.

## Personal Notices

**BIRTHS**

**Baddeley.**—On Mar. 25, at Louise Margaret Hospital, Aldershot, to Phylis (*née* Cooper), wife of Sqn. Ldr. E. S. Baddeley—a daughter.

**Bennett.**—On Mar. 21, at R.A.F. Hospital, Halton, to June (*née* Pollard), wife of Sqn. Ldr. M. Bennett—a son.

**Curtiss.**—On Mar. 23 at the Louise Margaret Hospital, Aldershot, to Peggy (*née* Bowie), wife of Sqn. Ldr. J. Curtiss—a son.

**Dickinson.**—On Mar. 24, at the West Norwich Hospital, to Merle (*née* Williams), wife of Sqn. Ldr. R. J. F. Dickinson—a son.

**Gillard.**—On Mar. 13, at Leanchoil Hospital, Forres, to Ella (*née* Smith), wife of Flt. Lt. E. Gillard—a son.

**Kingdon.**—On Mar. 24, at Ely, to Antoinette (*née* Bailey), wife of Flt. Lt. R. Kingdon—a daughter.

**Parker.**—On Mar. 2, at the Louise Margaret Hospital, Aldershot, to Mary (*née* Pocock), wife of Flt. Lt. G. A. Parker—a son.

**Raggett.**—On Mar. 20, at Harrogate General Hospital, to Pamela (*née* Faulkner), wife of Flt. Lt. P. Raggett—a daughter.

**Richard.**—On Mar. 24, at Wellington, to Janet (*née* Oldershaw), wife of Flt. Lt. D. M. Richard—a son.

**Sprent.**—On Mar. 20, at Portwey Hospital, Weymouth, to Carol, wife of Flt. Lt. C. Sprent—a son.

**Tanner.**—On Mar. 23, to Nancy, wife of Flt. Lt. A. T. Tanner—a daughter.

**Taylor.**—On Mar. 16, at Dhekelia, Cyprus, to Pamela (*née* Barton), wife of Flt. Lt. G. K. Taylor—a son.

**MARRIAGE**

**Howes—Warren.**—On Mar. 25, Wg. Cdr. Charles Clement Howes, to Wg. Off. Constance Ellen Warren, W.R.A.F.

**DEATHS**

**Jordan.**—On Mar. 26, Sqn. Ldr. Arthur Dean Jordan, D.F.C., D.L., R.A.F. (retd.).

**Ridley.**—On Mar. 25, Air Cdre. Eric Leighton Ridley, R.A.F. (retd.).

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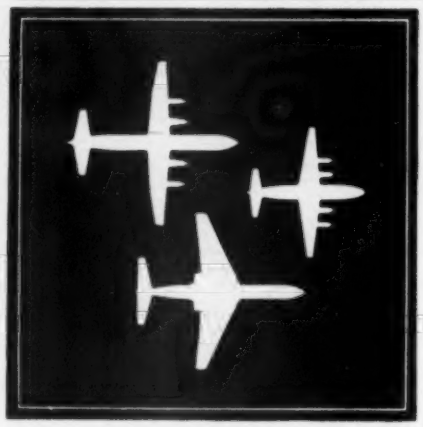

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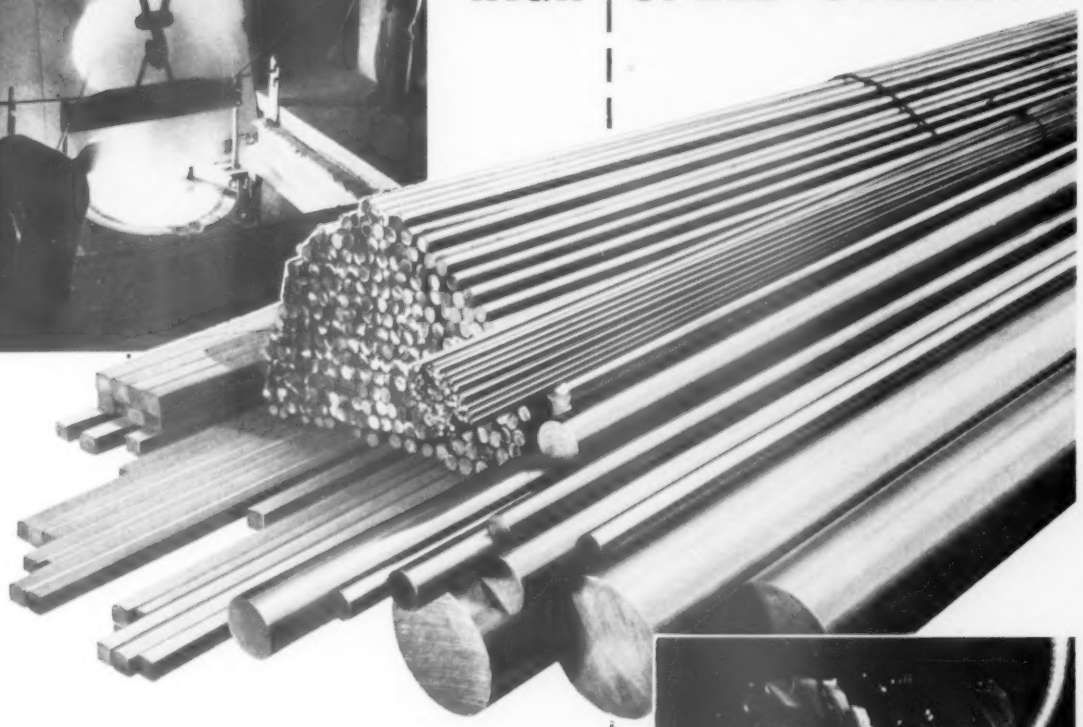

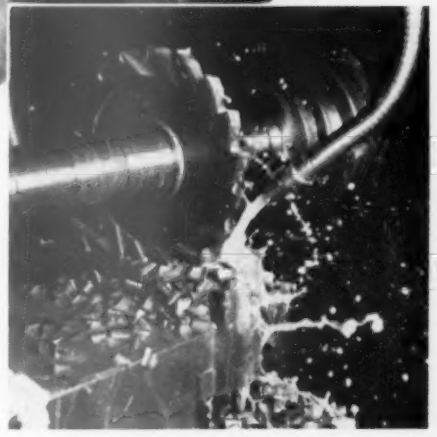

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